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QUARRY AND CRUSHING PLANT SUPPLYING STONE FOR ROADBUILDING IN THE HEART OF THE BEAUTIFUL ADIRONDACK MOUNTAINS

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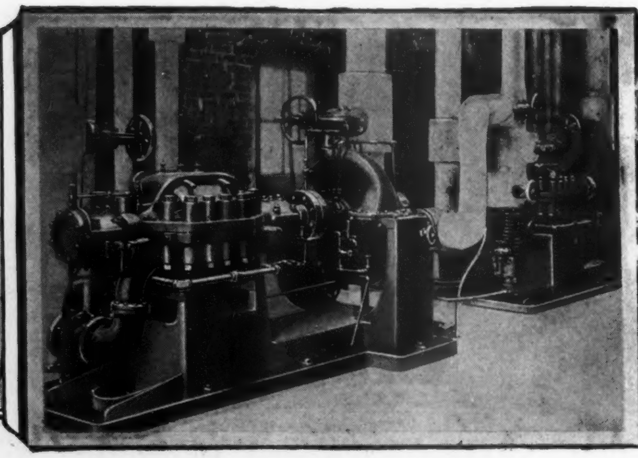

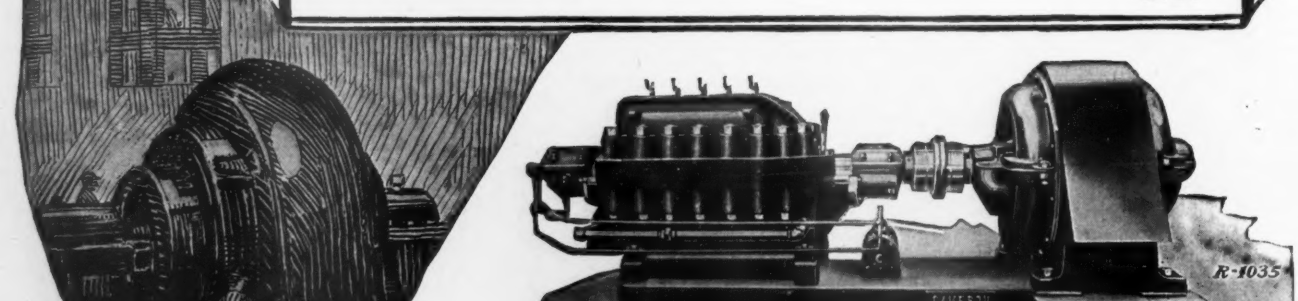
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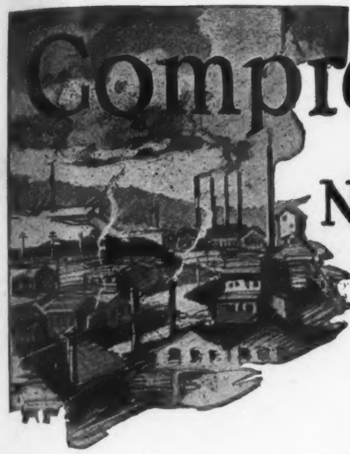

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Roadbuilding In The Adirondacks

Portable Compressors and Air-Driven Rock Drills Hasten the Completion of a Scenic Highway

By S. G. ROBERTS

THE substitution of motor cars for horse-drawn vehicles has necessitated revolutionary changes in road construction. This is notably the case in those sections of the country where winding highways prevailed until recently because they offered the easiest routes for the horse and the readiest solution for the roadbuilder faced with the problem of sidestepping rocky obstructions.

The accompanying story illustrates how modern equipment make it possible to push forward road work through a mountainous region where much rock must be cleared away in eliminating curves so as to insure a higher measure of visibility to the speeding motorist. Incidentally, it is made clear that compressed air is indispensable to the rapid prosecution of such projects.

MOTORING in the beautiful Adirondack Mountains—an ever-increasing delight to a continually growing number of car owners—is being made still safer and more enjoyable, thanks to certain work being done, with Federal aid, by the State of New York.

The roadbuilding we have in mind covers an aggregate of substantially 25 miles of that much traveled Montreal Trail lying between Chestertown on the south and Elizabethtown on the north. This highway traverses what might be termed the lower ranges of the Adirondacks, and is replete with picturesque vistas and expanses from end to end. The country traced by the road is for the most part historic ground and long was the route by which the hunter, the health seeker, and the nature lover penetrated the fastnesses of the Adirondack Wilderness or halted at the less inaccessible communities and camps. Let it be recalled that the Indians wandered to and fro over the whole region—some of their trails having blazed the way for the roads later built by the white man and still later developed for the accommodation of comparatively modern vehicles.

Few of the people that now motor over the route between Chestertown and Elizabethtown realize how much the highway engineer has done for them and how much speed and ease of travel have advanced in that part of the country within the last three decades. Many persons acquainted with the Adirondacks can readily recall when horse-drawn vehicles were the only means of transportation over those hills and mountains when once the traveler had parted from the railroads that tapped the rugged territory at a few widely separated points. These recollections invoke mental pictures of the adaptable buckboard and the more pretentious stagecoach—the stagecoach linking the more important communities while the buckboard answered as a conveyance for shorter distances or as a feeder to and from places harder to reach.

In his *History of the Adirondacks,* Alfred L. Donaldson has described feelingly the part played by the stagecoach from 1855 to 1890, when that type of vehicle was depended upon almost wholly for the carriage of people, parcels, mail, and even news. As he expresses it: "Its coming and going was the event of the day, a ceremonial that even the busiest would seldom miss. The passing by of the stage often marked the lapse of time along its route. The crack of the whip and the rumble of wheels replaced the clock in many a roadside home. The driver of the stage knew everybody. He carried messages and did errands. He brought medicine to the sick, and cheer and friendly gossip to the lonely.

"Men of sterling parts, skilled in the handling of four to six horses, cool and resourceful in danger, hardened to fatigue and exposure. And they needed these qualities, for their calling was no easy one. The corduroy roads of those days were made to try men's souls. They were at best narrow and bumpy, full of treacherous holes, and thick with sand or deep with mud. The grades were steep; and the curves abrupt. The men who drove their human loads from 30 to 40 miles daily over them, in all kinds of weather and often after dark without ever meeting with a fatal accident, obviously deserve more credit than a careless world is apt to give to routine merit."

The main stage routes of those earlier days started from Elizabethtown, Keeseville, and Ausable Forks. Most of the travel entered the region through Elizabethtown; and many of the people reaching Elizabethtown from Lake Champlain landed at Westport nine miles away. From Elizabethtown—the county seat of Essex County, the traveler could be driven thence into the heart of the central Adirondacks or make his way southward to Chestertown and thence on to Glens Falls and Albany along the highways built to facilitate that traffic.

As can readily be understood, in those days the roadbuilder followed as far as possible the line of least resistance. He was fully alive to the limitations of horseflesh, even when of the best; and he traced a circuitous route if by so doing he could avoid steep grades.

But grades were by no means the only problem with which he had to contend. On almost every side he was confronted by outcropping rock that formed the underlying mass of the surrounding hills and mountains. At that time he had at his disposal only comparative-



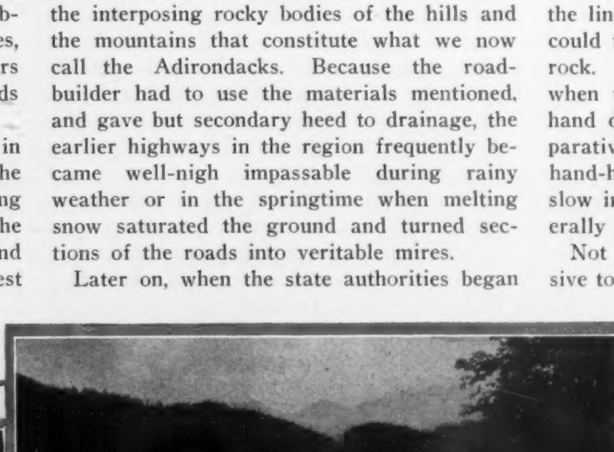
Roadbuilding activities between Taylors and Schroon Lake Village.

ly crude means or instruments with which to clear away the rock that jutted into his path or stood squarely athwart the route that he might prefer to follow; and, therefore, he not infrequently skirted around a ledge that lay between him and the shortest line to his objective. These detours, these varying curves, had their compensations during those years when vehicular traffic moved over the roads in a somewhat measured fashion.

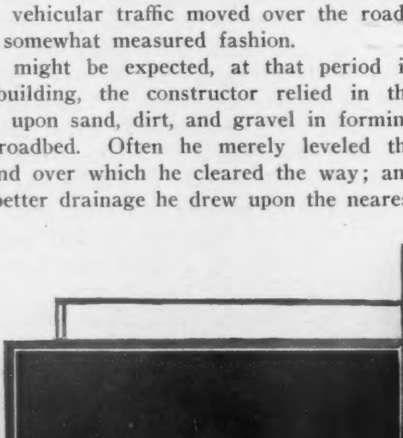
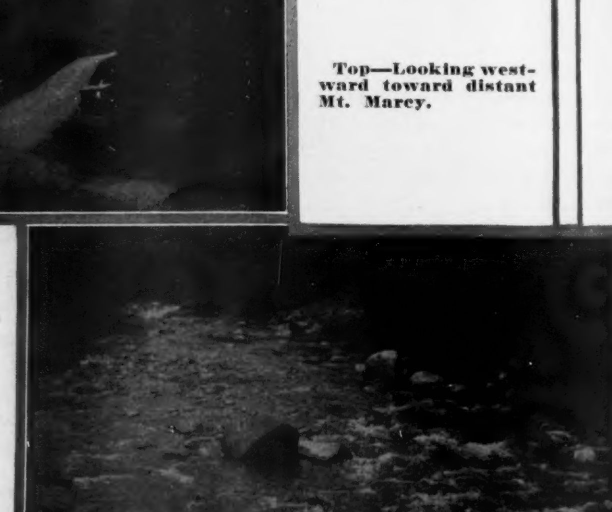
As might be expected, at that period in roadbuilding, the constructor relied in the main upon sand, dirt, and gravel in forming the roadbed. Often he merely leveled the ground over which he cleared the way; and for better drainage he drew upon the nearest convenient deposit of sand and gravel—materials that told in their mute way the story of the ages gone when the retreating ice cap ground its resistless course to lower levels, pulverizing, granulating, and wearing down the interposing rocky bodies of the hills and the mountains that constitute what we now call the Adirondacks. Because the roadbuilder had to use the materials mentioned, and gave but secondary heed to drainage, the earlier highways in the region frequently became well-nigh impassable during rainy weather or in the springtime when melting snow saturated the ground and turned sections of the roads into veritable mires.

Later on, when the state authorities began the general improvement of these highways so that they would be more suitable for motor-car traffic, the engineers adhered closely to the routes followed by the established roads—making only occasional alterations in the lines and dodging as far as they possibly could the drilling and blasting of interfering rock. That course is understandable now when we consider the expense incidental to hand drilling. Even though labor was comparatively cheap, still the sledge and the hand-held drill made footage tedious and slow in penetrating the hard rock which generally prevails in the Adirondacks.

Not only was it disproportionately expensive to remove rock in order to insure a more



Top—Looking westward toward distant Mt. Marcy.

Bottom—Two views of the picturesque Bouquet River.

Fig. 1—Here is where Nathan E. Young, one of the contractors, quarries much of the stone used by him in building his section of the road between Chestertown and Elizabethtown.
Fig. 2—At the left is being drilled and blasted through rock a straight cut to eliminate the sharp and dangerous curve on the right.
Fig. 3—"Jackhamers" make comparatively short work of blockholing boulders and big pieces of rock obstructing the new right of way.
Fig. 4—Portable compressors, both out in the open and under cover, are furnishing motive air for rock drills and drill sharpeners.
Fig. 5—The "Leyner" sharpener has lightened the task of the blacksmith and helped the driller by making it possible to turn out quickly and surely drill steels of uniform excellence.

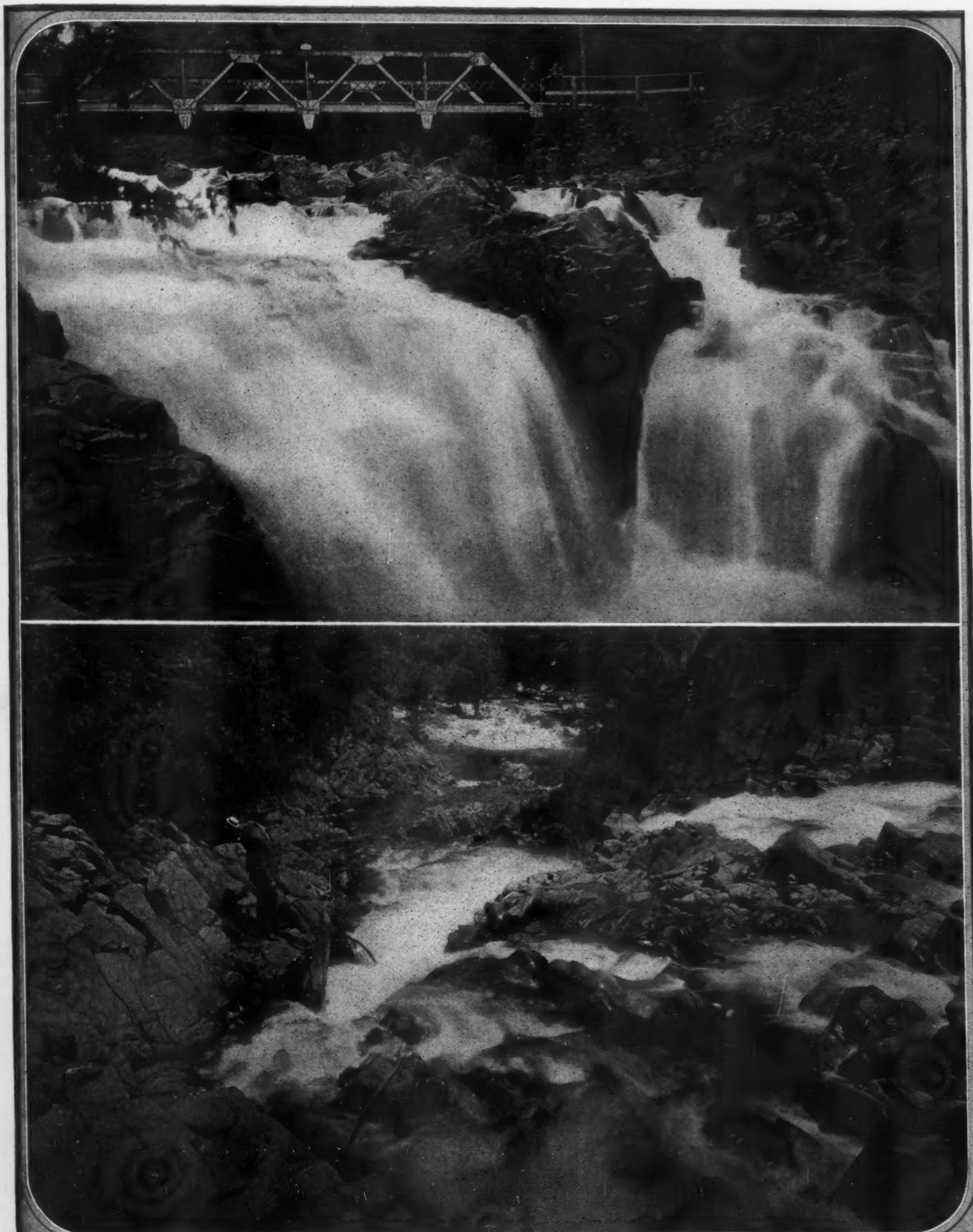
Where the road runs between North Hudson and New Russia.

direct road, but the engineer was likewise unable to get in sufficient quantity the broken rock that he would have liked to use in providing a stabler and more easily drained foundation for his road. He could have obtained that rock in sufficient quantity and in the right condition only by drilling and blasting neighboring ledges and then by breaking it up into suitable sizes by hand hammers or sledges. Thus, we see, that the roadbuilder was handicapped for years by a lack of mechanical facilities; and he pursued his way adapting his routes to the circumstances forced upon him by Nature rather than by overcoming the physical obstacles that beset his path. This was probably the best solution of the difficulty, because at that stage in the development of the motor car the self-propelled vehicle was an indifferent hill climber and the grades that had so long suited the capacity of the horse were tax enough upon the prime mover of the automobile.

But as the engine of the motor car was improved; as the motors became more and more powerful; and as speeds were reached that had not previously been widely attainable, then touring in the Adirondacks and over similar country elsewhere became fraught with dangers because of these higher speeds. It became imperative that steps should be taken to improve the visibility of the road ahead for as long a distance as practicable; and this logically involved the straightening out of lines and the studious avoidance of blanketing or obscuring curves. Gradients are now matters of secondary importance, because the modern automobile can mount well-nigh any slope at a goodly clip—unlike the horse of old. It is mainly with an eye to improving visibility that the Department of Highways of New York State is now spending substantially $900,000 on the road between Chestertown and Elizabethtown. Within the five sections involved—having an aggregate length of 24.96 miles, the five contractors concerned are called upon to clear away almost 25,000 cubic yards of rock. The prosecution of this work is striking evidence of the means now available to the roadbuilder in getting rid of obstructions of Nature's making.

The five contracts in question are reconstruction jobs that entail road widening, the

Left—Portable compressor supplying air to rock drills on the section of road awarded Ryan Brothers & Campo. Right—The quarry from which Ryan Brothers & Campo obtain much of their crushed stone.



Top—Where the Loon Lake-Elizabethtown road crosses the Bouquet River at Split Rock Falls.
Bottom—The picturesque Bouquet River just after passing beneath the bridge above. At this point the stream makes a drop of nearly 100 feet before reaching the bottom of the gorge.

elimination of dangerous curves, and giving the highway a new bituminous penetration top. With few exceptions, the straightening out of the route has necessitated more or less extensive rock excavation, and in many places the widening of the roadway has required the same thing. This explains why so much rock must be removed. In some instances, this rock has been utilized in the roadbuilding operations, but, generally speaking, much other rock has been and still is being quarried to provide essential material for the construction of this thoroughly modernized highway.

Persons familiar with the tedious practice of hand drilling for blasting that prevailed for years when roads were under construction in the Adirondacks will probably ask: How can this essential work be done now, and done rapidly, at a reasonable cost? And the answer is that the contractor now has available air-driven rock drills and portable compressors that can be shifted quickly and easily from point to point as the road jobs advance. While other up-to-date mechanical equipment are helping to expedite operations and to insure satisfactory results, still, in the last analysis, the rock drill and the portable compressor are bearing the brunt of the work on most of these undertakings.

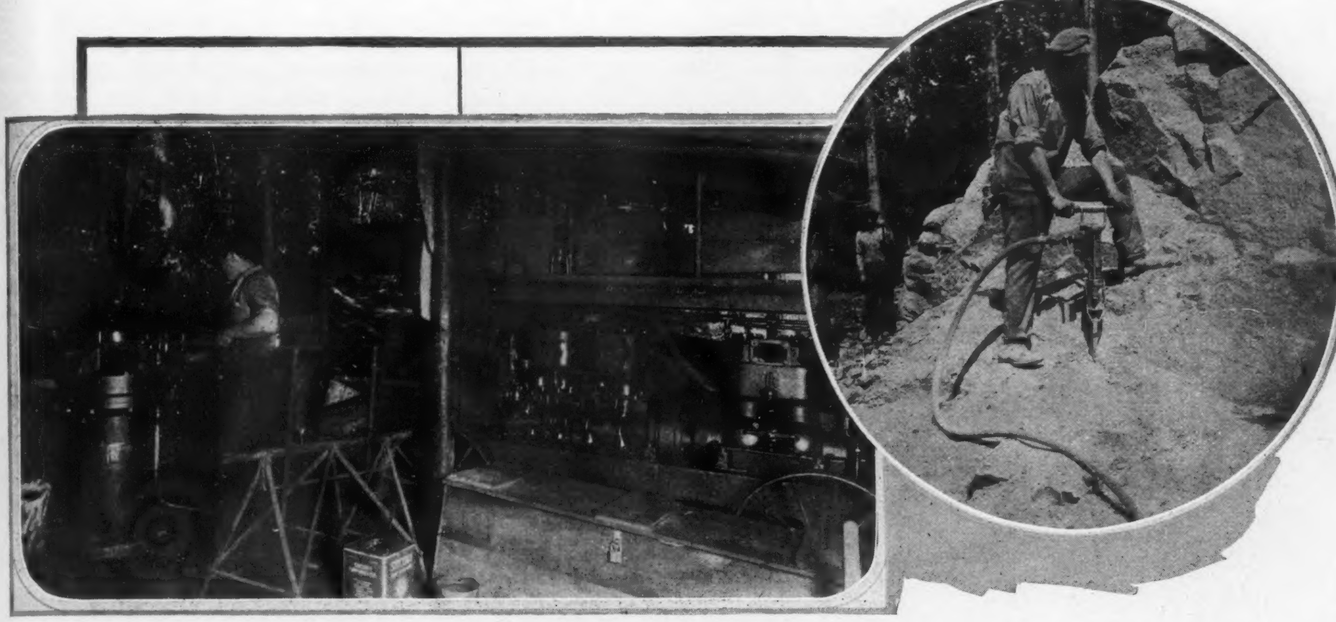
It might help to a clearer grasp of what is being done if we take up successively the different contracts—starting at the southern end of the field of operations. The first contract covers a distance of 5.04 miles and extends from Loon Lake to Pottersville—Pottersville being nine miles to the north and west of Chestertown. This contract was originally awarded to S. J. Groves & Sons Company, of St. Paul, Minn., who sublet it to the Kemp Brothers Construction Company, also of St. Paul. The latter concern is now doing the work on the basis of a contract price of $171,-932.95. This particular section of the highway traverses fairly open country, and will involve the excavating of probably not more than 900 cubic yards of rock. Even so, the contractor has had to open up a quarry in order to provide essential stone for roadbuilding.

This quarry is situated about mid-length of the contract section, where the Kemp Brothers Construction Company has established a blacksmith shop and where it has stationed the 8x6-inch I-R portable compressor which provides operating air for the DCR "Jackhamers" used in the quarry. This compressor also furnishes air to the No. 33 "Leyner" sharpener in the blacksmith shop. This sharpener forms the shanks and bits on all the drill steels needed in getting out rock from the quarry.

Adjacent to the quarry there is a crusher that is driven by an 80-H.P. internal-combustion engine. Broken stone is delivered from the pile to trucks for distribution by a tractor elevator. Where concrete is used, a power-driven portable mixer does the work. As may be readily grasped, the employment of mechanical apparatus of one sort or another reduces the measure of manual effort—making it practicable to forge ahead with the work with a comparatively small number of hands.

"Jackhamers," "Leyner" sharpeners, and portable compressors doing effective work in removing rock along the reconstructed highway between Loon Lake and Elizabethtown, N. Y.

From Pottersville onward to Taylors, on Schroon Lake—where the line runs that separates Warren from Essex County—this 3.89-mile section of road is being constructed by Louis Longhi & Son, of Torrington, Conn. In this case, the route traces its way over rather rough country; and, in doing the required straightening and widening, the contractor will have to remove a total of about 5,600 yards of rock. The contract price for this section is $148,458.50. Both BCR and DCR "Jackhamers" are being used to clear away rock along the way and to get out rock for roadbuilding purposes. Compressed air for the rock drills and for operating the No. 33 "Leyner" sharpener, in the blacksmith shop, is



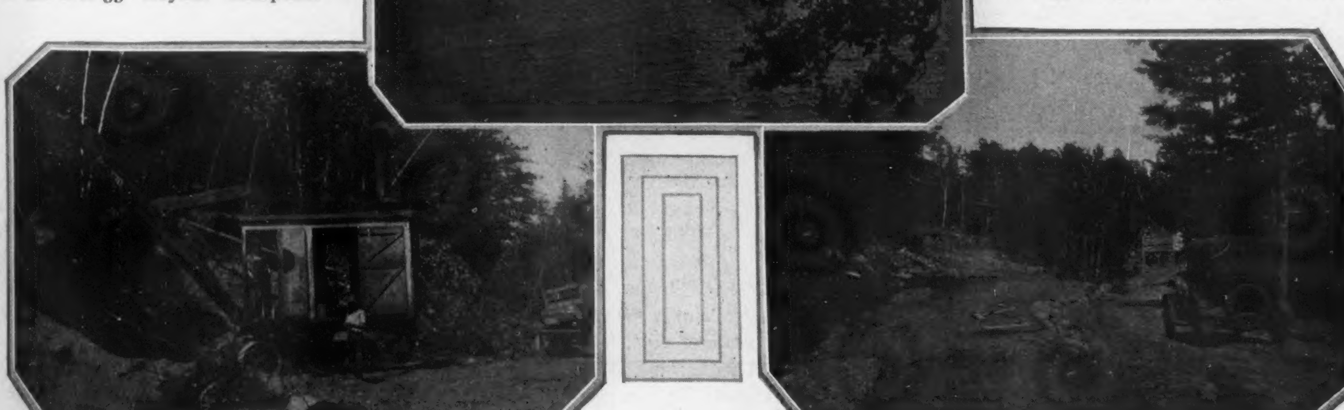
Left—Blacksmith shop of Louis Longhi & Son equipped with a "Leyner" sharpener and a portable compressor. Right—One of the "Jackhamers" engaged in drilling rock in a deep cut on the same contract.

furnished by two Type Twenty portable compressors—one an 8x6-inch and the other a 10x 8-inch unit. Much of the rock handled by the crusher, that prepares the rock for use on the road, has been obtained up to date from rock drilled and blasted in making a large cut to straighten the road where a wide and dangerous curve has heretofore imperiled speeding motorists.

A stretch of 5.37 miles of road, lying between Taylors and Schroon Lake Village, is being built by Louis Mayersohn, of Albany, N. Y. The contract price for this section is $189,-427.50. Although the original estimate called for the removal of only 1,300 cubic yards of rock, there is every reason to believe that the contractor will have to clear away fully 5,000 cubic yards of rock before the job is finished. To do this work expeditiously and also to provide rock for roadbuilding, the contractor has in service two 8x6-inch Type Twenty portable compressors. These compressors furnish air to the DCR "Jackhamers" in use and to the No. 33 "Leyner" sharpener set up in the blacksmith shop adjacent to the quarry. The rock crusher is driven by a 50-H.P. steam engine.

From Schroon Lake Village northward, for a distance of 20 miles, the road is still in good condition and has not called for widening or straightening. At the end of these 20 miles, however, the traveler comes to Underwood, and from there on to New Russia—a matter of 3.02 miles—where Ryan Brothers & Campo, of Dansville, N. Y., have a contract that will involve an outlay of $116,684. All told, the contractor will probably excavate 6,080 cubic yards of rock in broadening and in removing objectionable curves along the way. The contractor is using DCR-23 "Jackhamers" for rock drilling, and he relies upon an 8x6-inch Type Twenty portable for the necessary compressed air. A striking feature of the work is the quarry from which the contractor obtains a good deal of the rock for roadbuilding. This quarry has a sheer face nearly 100 feet high, which makes it easy to drop the blasted rock at the foot of the cliff and close to the crushing plant established there.

The last of the contracts is that covering the highway from New Russia to Elizabethtown—a stretch of 7.64 miles. This, the longest section undergoing improvement, will cost $251,-803.10; and will probably require, by the time it is finished, the excavating of 7,300 cubic yards of rock. The contractor is Nathan E. Young, of Union, N. Y. For the removal of rock along the way and for drilling in his well-equipped quarry, Mr. Young has two portable compressors—one an 8x8-inch Type Fourteen and the other a 10-8-inch Type Twenty unit. In the blacksmith shop, adjacent to the quarry, the contractor has in service a No. 33 "Leyner" sharpener which takes



Schroon Lake and parts of the neighboring motor highway now undergoing reconstruction.

care of all his drill steels. His drilling is done with DCR and BCR "Jackhamers." Rock is moved from the quarry to the crusher over a narrow-gage line on which small cars are pulled to the dump by means of a steam hoisting engine and a cable. The activities at the quarry and crushing plant are skillfully organized; and work on this section of the road is advancing rapidly because of carefully coördinated efforts. Indeed, rapid progress has been made on all the associated contracts; and the motoring public will have many reasons for rejoicing when thousands of its cars move freely over this picturesque highway in the lower Adirondacks.

When completed, this stretch of the Montreal Trail is likely to be used increasingly by tourists and others in pursuit of pleasure or business beyond our northern boundaries. The road work now in hand calls for a highway measuring 28 feet from shoulder to shoulder, with a pavement generally 18 feet wide but somewhat broader on curves. The type of construction is what is technically termed "bituminous macadam"—a form of construction which necessitates the use of much rock of different sizes. This, in itself, explains how important are the parts being played by air-driven rock drills and portable compressors.

In the choice and the providing of the machinery and other equipment that are aiding in hastening this roadbuilding program, the well-known firm of Collin, Fox Company, Inc., of Glens Falls, N. Y., has been conspicuous.

Some of the activities in the blacksmith shop and in one of the quarries along that section of the road being built by the Kemp Brothers Construction Company.

NEW PORT FACILITIES FOR LONDON

THE fact that shipping using the Port of London in 1925 reached the record figure of 47,000,000 net registered tons has impelled the authorities to undertake necessary harbor improvements. For this purpose, an expenditure of £4,000,000 has been authorized; and work on the first contract is underway.

This contract involves the enlarging of the Tilbury docks so that they will be able to take care of the largest vessels afloat. Additional facilities planned for Tilbury include the construction of a new entrance lock, 1,000 feet long and 110 feet wide, to the dock system; a new graving dock; and a passenger landing stage. The new graving dock is to be 750 feet long and 110 feet wide, and should be capable of filling requirements for many years to come. However, it is so designed that it can be easily lengthened to 1,000 feet should service conditions demand it.

The passenger dock, which is to be patterned after the great landing stage at Liverpool, will be 1,140 feet long and will have sufficient depth alongside to accommodate the biggest steamships. This will enable passengers to embark and to land without the inconvenience and delays connected with the use of tenders. By arrangement with the London, Midland & Scottish Railway, a station in direct rail communication with the new stage will be built and equipped to deal with liner traffic.

Recent government estimates reveal that a total of $632,444,000 is invested in the Canadian mining industry. Ontario is undoubtedly the most active province in this department of endeavor, accounting for 41 per cent. of the capital so invested. British Columbia comes next, with 17 per cent.; then Alberta, with 14 per cent.; Quebec, 12 per cent.; Nova Scotia, 9 per cent.; Yukon, 4 per cent.; and New Brunswick, Manitoba, and Saskatchewan, each with 1 per cent.

It is reported that plans have been made for the electrification of about 93 miles of the Scrocabana Railway from Sao Paulo to Santo Antonio, Brazil.

Summary of a Talk on the Development of High-Pressure Centrifugal Pumps

POWER-DRIVEN pumps have so much to do in many of the departments of our complex industrial life that most of us accept these machines as commonplace agencies for the handling of various sorts of fluids. It might, therefore, serve a useful purpose to recall how some of these pumps have evolved in the course of a comparatively few years. Therefore, we take pleasure in reproducing the high points of a talk given recently, in Chicago, by H. S. Budd before a meeting of the Stationary Engineers' Society.

"The simplest and the crudest contrifugal pump is, of course, the open impeller type, sometimes called the fan pump, and the earliest contrifugal pumps built were of this variety. Open impeller pumps may be of the single- or double-suction type, and are applicable to heads of about 60 feet. They are not very efficient on account of slippage and a poor form of casing. This type also has trouble with end thrust along the line of the shaft, which becomes considerable at the higher heads.

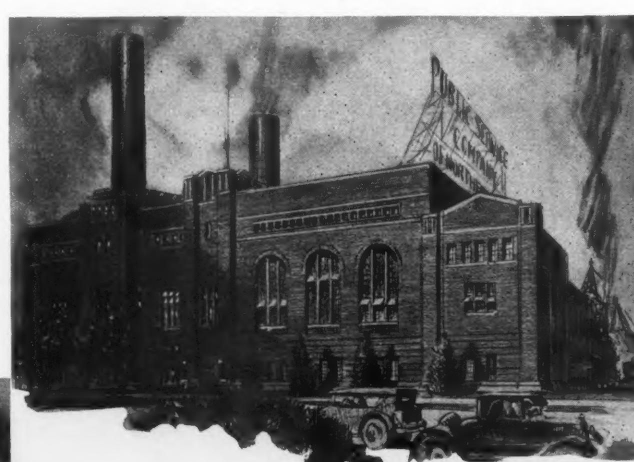
"By using a closed type of impeller, with a close-running clearance around the hub, the slippage and the internal leakage are very much reduced and the efficiency greatly improved. Hence, this type is applicable to higher heads. Some single-stage pumps have been built with diffusion vanes to increase the efficiency, but their value in this direction is doubtful as compared with a well-designed volute casing, which is in reality a long diffuser. The large, single-stage pumps which furnished water for the cascades at the St. Louis Exposition had diffusers, and the head was about 100 feet. This was considered a high head for a single-stage pump at that time.

"Until a few years ago, a head of about 150 feet was believed to be the limit for a single-stage pump. Then higher heads were obtained by arranging two or more stages in series—that is, by multi-stage pumps. This rather arbitrary change from single to multi-staging was determined largely by efficiency considerations—in other words, the multi-stage pump was the one selected because it required less power and was more efficient. It was also generally thought that there was less wear on the internal parts of multi-stage pumps; but this opinion is unfounded in suitably built pumps, except perhaps in some individual cases.

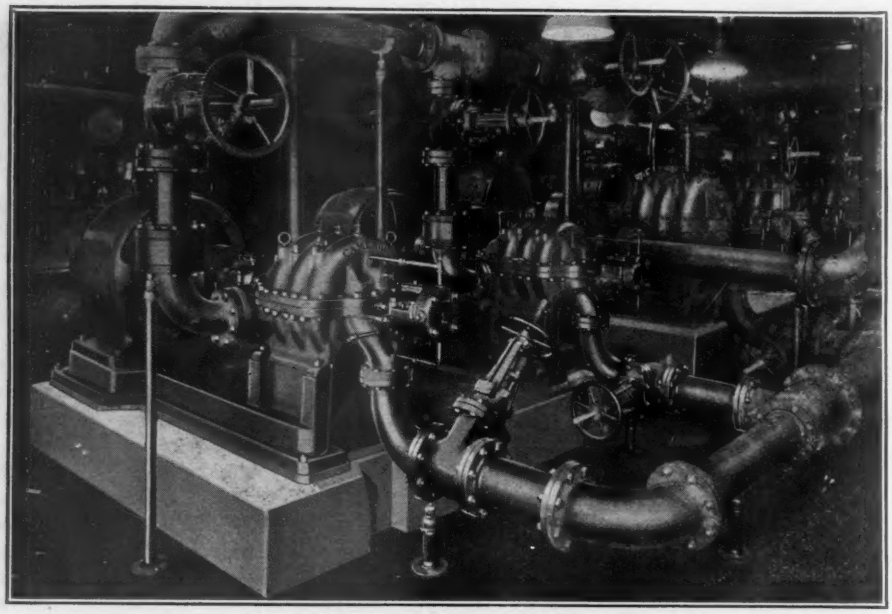
"Improvements in the design of single-stage pumps, bringing higher efficiencies, upset this order of things; and, provided they were built heavy and substantial enough to withstand the added pressure and horsepower, these improvements increased the head range of single-stage pumps. Conventionality and conservatism had to be overcome, of course, and some manufacturers were slow to adopt the new ideas; but it is quite a common thing now to see single-stage pumps of moderate capacity operating efficiently on heads of 100 pounds. In fact, in special cases where efficiency is not a prime factor they can operate on much higher heads. These same arguments apply as well to each impeller or stage of a multi-stage pump.

"One of the early uses of centrifugal pumps, especially where electric power was available, was in mine pumping, inasmuch as such installations did away with cumbersome steam pumps that required large and expensive pump rooms underground, hot steam pipes in the shafts, and called for the disposal of the exhaust steam underground. The first mine installations were made abroad and in deep metal mines where the head averaged several hundred feet. Multi-stage pumps were placed at various levels—say, 300 or 400 feet apart—up the shaft. A suction well was provided for each pump, and the pump below delivered into the suction well of the pump above. In this way, the water was raised surfaceward in succession by the several pumps without putting excessive pressure on any one of them. There is an installation of this kind on the property of the well-known Homestake Gold Mining Company, at Lead, S. D. The water is elevated about 1,700 feet by a series of five pumps located at equi-distant points up the shaft.

"Later on, higher heads were handled by a single unit consisting of two multi-stage pumps in series connected to the same driver, usually placed between them. Heads of from 1,200 to 1,500 feet, equivalent to from 500 to 600 pounds, have been handled nicely with pumps arranged in this fashion. Under such conditions, the shell or casing of the second or high-pressure pump must be strong enough to withstand the added pressure; but there is no increase in the pressure difference per stage.



Top—Waukegan Station of the Public Service Corporation of Northern Illinois.
Left—Columbia Power Station of the Columbia Gas & Electric Company of Ohio.
Right—Twin Branch Station of the American Gas & Electric Company, Mishawaka, Ind. In all these plants are installed Cameron boiler-feed pumps.



Three No. 6, Class "ST," 4-stage pumps and two No. 4, Class "MT," 4-stage pumps in elevator service.

"High-pressure water is quite extensively required in hydraulic cylinders used in steel plants for various purposes about the rolls and the Bessemer converters, as well as for operating shears and presses. Centrifugal pumps, direct connected to either motors or turbines, are especially suited to this work. The pressure usually ranges between 500 and 700 pounds.

"Centrifugal pumps have long been recognized as ideal boiler feeders, and at present we find that they are almost exclusively employed for this purpose in power plants of medium and of large horsepower capacities. In this service, reliability and simplicity of design and construction, combined with reasonable efficiency, are of prime importance. The water handled is fresh and free of all destructive grit or foreign matter. It is usually condensate, and ofttimes thoroughly aerated.

"These qualifications have led to still higher pressures per stage than heretofore advocated; and the results have been very gratifying. A single-stage pump of somewhat special design, with all parts strongly and substantially built and with effective joints between the impeller and the casing to minimize internal leakage, will operate for long periods on pressures of several hundred pounds without much deterioration or fall in capacity. These facts, verified by the performances of many installations, have recently led to the development of multi-stage pumps using a single casing that operate at moderate speeds and that develop pressures not considered practicable a few years ago.

"Of course, these high pressures have introduced some very difficult problems that the pump builder has had to solve. They included, among other things, form and strength of casing, and new methods of packing between the casing joints. The internal parts and joints must be protected against rapid wear from wire drawing and erosion; and the ever-present problem of compensating for end thrust along the line of the shaft had to be satisfactorily met. The bearings must be of suitable type and provided with effective oiling devices applicable to the high power and speeds involved.

"The following brief description of some of the more important boiler-feed installations will perhaps best serve to illustrate what has been accomplished along these lines:

"The Waukegan Generating Company, Waukegan, Ill., introduced the first high-pressure station in that region. It operated on 350 pounds steam pressure, 460° superheat, and 475 pounds water pressure. In 1923, this company put in service three No. 6, 4-stage boiler feeders, and later on added a fourth unit. Two of these are motor driven and two turbine driven. A recent inspection showed no wear of any consequence on any of the parts.

"Midwest Utilities, Grand Tower, Ill., same steam and water conditions as at the Waukegan plant. Two No. 5, 5-stage boiler feeders were obtained in 1923, and a third one in 1924.

"Ohio Power Company, Philo, Ohio, owned by the American Gas & Electric Company. The plant was originally operated on 500 pounds steam with superheat, and 650 pounds water pressure. Later the steam pressure was raised to 600 pounds steam and 750 pounds water pressure—using four motor-driven No. 6, 6-stage boiler feeders: two installed in 1924 and two later on.

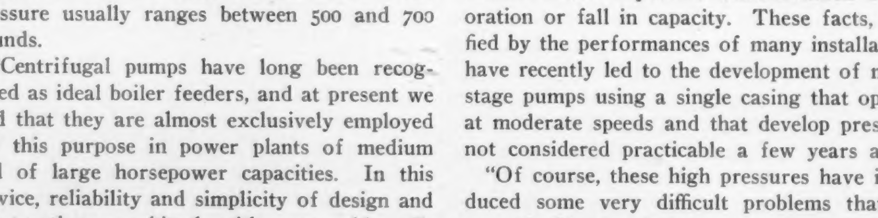
"Twin Branch Power Company, Mishawaka, Ind., 500 pounds steam with superheat, and 650 pounds water pressure. Two No. 6, 6-stage, motor-driven pumps installed in 1925.

"Columbia Power Company, Miami Fort Station, Cincinnati, Ohio, 550 pounds steam with superheat, and 680 pounds water pressure. Six No. 4, 6-stage pumps, four motor driven and two driven by Terry turbines. Installed in 1925.

"Commonwealth Edison Company, Crawford Station, Chicago, Ill., 550 pounds steam, total temperature 750° F., 675 pounds water pressure. Later, the steam pressure was increased to 600 pounds, and water pressure to 800 pounds. Two No. 6, 4-stage, motor-driven pumps, making 3,580 revolutions a minute, were placed in service in 1924. Recently there have been added another pump of the same kind and two No. 6, 6-stage units which make 1,750 revolutions a minute.

"It is interesting to note that one of the No. 6, 4-stage pumps was opened up for inspection after eight months of continuous operation. There was no sign of deterioration whatever on any of the parts. The clearance between the wearing rings on the impeller was only .04 inch, and that between the balancing drum and the sleeve only .03 inch—both but slightly more than the original clearances. No repairs were necessary before putting the pump back in service. No better evidence could be had of the entire practicability of the pressure of 200 pounds per stage.

"The tendency towards still higher steam and water pressures in public-utility power stations will continue to test the ingenuity of the pump builder in meeting the severe requirements—in fact, water pressures of 1,200 pounds are already a reality."



Two No. 6 "MT" 4-stage pumps, working in series, in a mine where they are operating against a total head of 1,250 feet.

Ice Plant for Cape May Fisheries

This Establishment is an Important Addition to the Town's Restricted Industries

By R. G. SKERRETT

CAPE MAY for more than a century has been a seaside resort known to thousands of people living in the eastern part of the United States. But it is not generally known how close is the kinship between the old families of the City of Cape May and the pioneers of Plymouth, Mass. Plymouth, in the decades gone, was one of the ports from which whaling ships sailed the seven seas in quest of those oil-producing mammals of the deep; and certain of the first settlers of Cape May were men from some of those wandering whalers. This fact is of present interest, because Cape May is becoming again increasingly important by reason of its fishing industry—the fish this time being of relatively small sizes and caught only because of their food value.

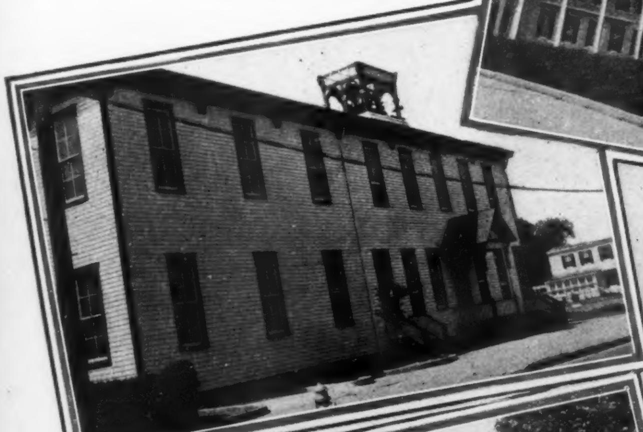
During the year 1925, there were caught in the waters adjacent to Cape May and shipped inland to markets substantially 12,400 barrels of fresh and appetizing fish of various sorts abounding at different seasons of the year. The period of greatest activity ranges between the 12th of April and the middle of May, during which time the offshore waters of the neighboring Atlantic teem with northward-bound schools of succulent mackerel. The preciseness of these limiting dates probably arouses the skepticism of the uninformed, because they do not realize how Nature regulates in a marvelous manner the coming and going of these itinerant schools.

Just where the mackerel emerges first in the early spring from the depths of the sea is not known save that that appetizing creature appears in the neighborhood of Cape Hatteras about the 20th of March, and thereafter works its way by easy stages up the coast until it arrives off the shores of Nova Scotia. And then, after they have brought wealth to the fishermen all along the way and gratification to millions of people familiar with the toothsome flesh of the mackerel, the schools suddenly disappear from the surface of the Atlantic—whither they go and where they stay during the months intervening before their return to the waters of our southern coast being a mystery still unsolved by scientists who have been seeking a solution for a great many years.

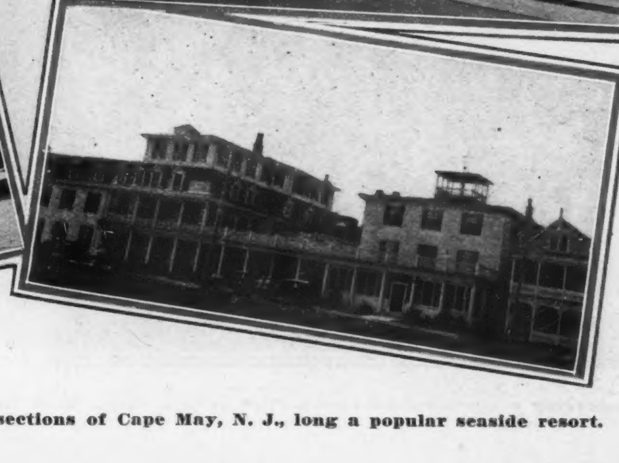
It is the appearance of mackerel off Cape May that gives the local fishermen their weeks of greatest activity and also draws to the neighboring waters the mackerel fleets of Boston and Gloucester. The mackerel caught at that time are dispatched mostly to Philadelphia and New York; but considerable quantities are also shipped further inland and to the South, as well as northward to Boston where they are in great demand.

The Boston and Gloucester mackerel fleets are made up of larger craft than those based upon Cape May. For a while Cape May becomes the port of entry of the entire flotilla: first, because Cape May Harbor—developed by the Federal Government—offers a convenient and safe haven where the fishing vessels can take refuge in times of storm and obtain certain essential supplies, and whence they can dispose of their cargoes in profitable markets. Among the supplies to be had is ice, which keeps the fish fresh until they are brought in to port and continues to keep them fresh until they are placed upon the table of the consumer.

On the western side near the southern end of Cape May Harbor is Schellenger's Landing, which has been a feature of the local fishing industry for years. Schellenger's is operated by Clarence Schellenger & Company, which has been in the fish-handling business and has furnished fishermen with fuel, ice, and other sup-





Glimpses of the residential, the hotel, and the business sections of Cape May, N. J., long a popular seaside resort.

Icing plant of Clarence Schellenger & Company, Cape May, N. J.

The dock where fishing boats are iced at the plant of Clarence Schellenger & Company.

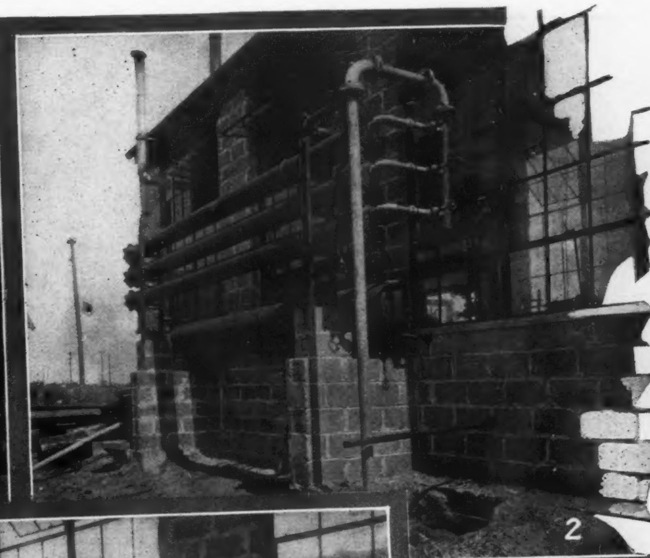
Unloading a mackerel fisherman filled with a cargo fresh from the deep.

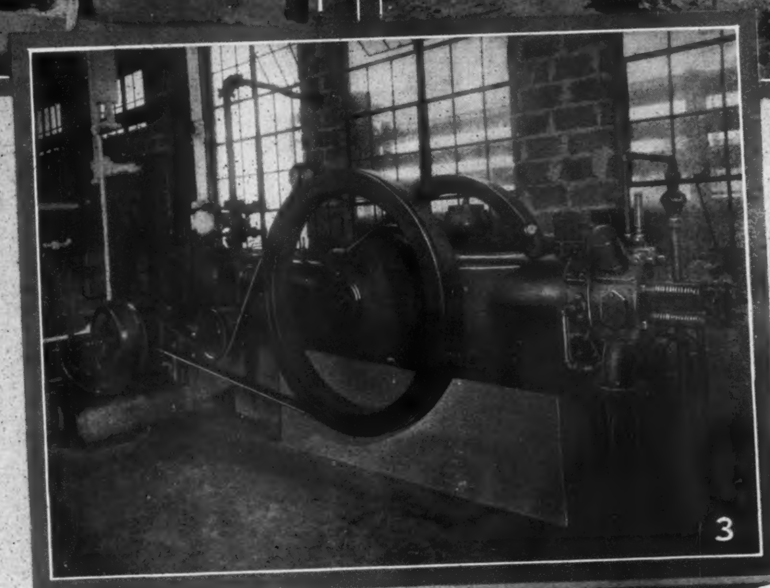
plies for some while. To those of our readers that may be unfamiliar with the operating of fishing fleets, let it be said that the larger boats generally go to sea and hold their positions in the offing until they have obtained a satisfactory cargo. To keep the accumulating fish fresh during these indefinite stays, each and every craft carries a variable supply of ground ice—depending upon the size of the vessel and the maximum length of time she may be away from port. Some of the boats will take out with them only 5 tons of ice in the bins in their holds while others will have aboard anywhere from 12 to 20 tons of ice. Very often the local fishermen will run in and out daily; but the bigger craft from Boston and Gloucester may remain at sea for a week, if necessary, to fill up with a profitable catch—hence the greater quantity of ice carried by these larger boats.

It should be self-evident that an ample quantity of ice must be available at Schellenger's Landing to take care of the needs of the 25 fishing boats forming the local fleet and of the flotillas sent southward from New England. Until recently, Clarence Schellenger & Company obtained its ice from a plant at Stone Harbor, 16 miles away. Last year, the Philadelphia & Reading Railroad determined to foster the fishing business at Cape May, and to this end the railway company built and equipped a refrigerating plant at Schellenger's Landing. The operating of this plant was taken over by Clarence Schellenger & Company. It has been running continuously since the 2nd of April of the current year, and is one of the few industrial undertakings within the municipality. Eventually the establishment will prove a boon not only to fishermen but to residents and to transient guests of the city.

For the sake of those interested in commercial fishing, let it be said that the boats of the mackerel fleet are divided broadly into two groups because of the different methods employed in catching the fish. The larger craft are the "seiners" while the smaller vessels are usually "netters." The "netters" set their gill nets on moonlight nights while the "seiners" operate as a rule only on dark nights; and in spreading their nets they are guided by the phosphorescent wakes of the schools as they swim about on or close to the surface of the water. In either case, the fish are lifted aboard as the nets are withdrawn from the water; and just as promptly the wriggling, flapping creatures are tossed into bins in the hold of the boat and buried beneath a covering of ground ice. Thus they are chilled and frozen before deterioration can begin; and, preserved in this fashion, they reach the landing. There they are packed in barrels, also filled with ice, and carried inland in refrigerator cars to the points of ultimate disposal. In this manner the freshness and the tastiness of the mackerel are safeguarded until the fish have reached the appreciative consumer.

Before describing the refrigerating plant, it may be well to enumerate the other food fish that are caught in the waters adjacent to Cape May and dispatched thence inland from Schellenger's Landing. Weakfish are taken





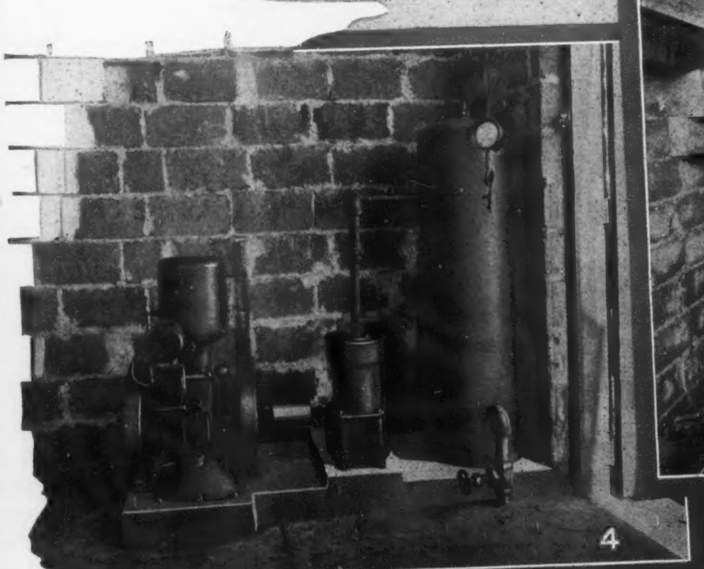


Fig. 1—Compressor room of the refrigerating plant at Schellenger's Landing.
Fig. 2—Ammonia condenser installed outside and adjacent to the southern wall of the refrigerating plant.
Fig. 3—Oil-engine ammonia-compressor unit of 30 tons refrigerating capacity. Note how the 18-kilowatt generator is belt driven from one of the flywheels.
Fig 4—The Type Fifteen I-R compressor, driven by a gasoline engine, that supplies starting air for the oil-engine ammonia-compressor unit.
Fig. 5—The tank room of the Schellenger refrigerating plant at Cape May, N. J.

Left—A busy day at Schellenger's Landing.
Right—Some of the craft that crowd Cape May Harbor when the mackerel season is at its height.

from the middle of May to October; and bluefish arrive about the same time in May and are caught from then on until fall. Porgies appear during May and are caught all summer; and sea bass are landed during the same warm months. Flounders, which often parade as sole in our restaurants, reach the vicinity of Cape May about the beginning of May; and certain of the fishermen make them their particular quest from then onward to November. From November to spring, while the Atlantic is cold, the cod works its way southward and is taken in large numbers.

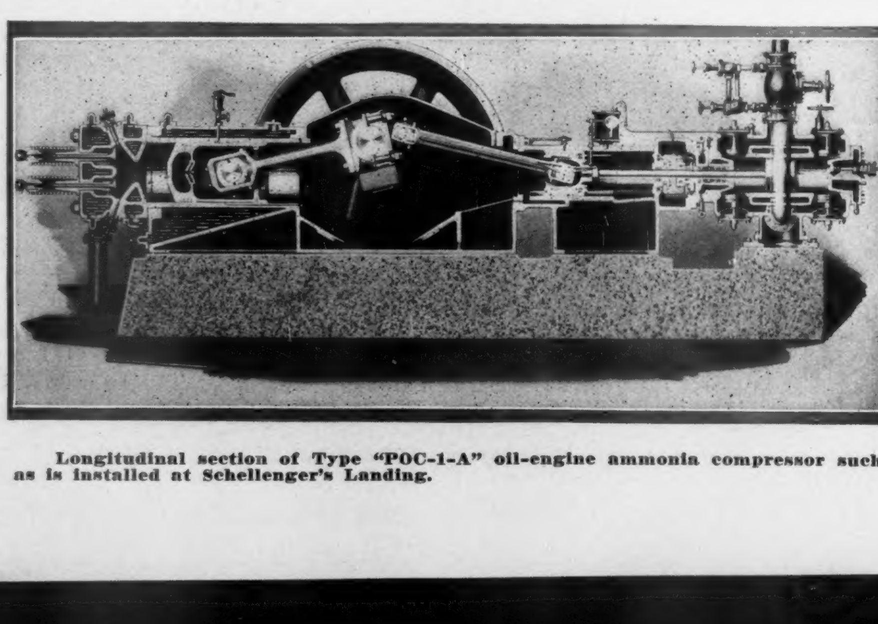
During the height of the mackerel season from 20 to 28 carloads of the fish are shipped away daily over the Philadelphia & Reading Railroad. Each car holds 50 barrels of fish packed in ice. Throughout the rest of the open season the average ranges anywhere from 500 to 600 barrels daily, although on occasions the per diem shipments may run a good deal lower. Most of the fish received at the landing are dispatched to the markets the day they arrive. These, like the fish in the holds of the boats, are packed in ground ice; and the landing is equipped with four grinders that convert the 300-pound cakes of ice into small bits. The purpose of this is twofold: first, the ice so prepared can be shoveled easily over the fish in the boats so as to envelope them completely; and, second, inasmuch as the ground ice melts faster than the cake ice, this action serves better to extract the animal heat from the fish and then to freeze them. This is because the water, formed in melting, must have restored to it a definite measure of the heat units that it parted with when it was frozen; and these heat units are withdrawn from the relatively warm bodies of the ice-covered fish. The ground ice is sold to the fishermen at $6 a ton.

Most of the catches, as previously mentioned, are dispatched from the landing the day they are delivered there from any of the fleet. At week-ends, when the boats come to spend a while in port, and at other times when the market is down, the fish are held in a sharp freezer—which is part of the plant—until the demand increases and prices rise. In the sharp freezer the temperature is maintained at 4° above zero Fahrenheit; and the freezer is large enough to accommodate 25 barrels of fish. In this way, what might otherwise invite a loss to the fishermen is turned into a source of profit; and, at the same time, the ultimate consumer is assured a wholesome and appetizing supply of fish.

The refrigerating plant at Schellenger's Landing was designed and equipped by the Henry Vogt Machine Company of Louisville, Ky., which has been in this particular line of business for years. The prime mover and the ammonia compressor are a combined unit of the well-known Ingersoll-Rand "POC-1-A" type—having a refrigerating capacity of 30 tons. The oil engine, which is of 50 H.P., represents a very economical form of prime mover; and the energy developed by it is transmitted directly to the ammonia-compressor cylinder by means of a common crankshaft interposed between the engine cylinder and the ammonia cylinder. This is shown in detail by an accompanying illustration of a longitudinal section of this very successful type of refrigerating unit. While rated at 15 tons of ice per 24 hours, the unit has been producing 17 tons of ice daily; and it has done this at a fuel cost of 24½ cents a ton.

An 18-kilowatt generator is driven by belt from one of the flywheels of the oil-engine-ammonia unit; and this dynamo furnishes operating current for two hoists, for two brine agitators, for two pumps, and for a blower that supplies air at a pressure of 3 pounds for agitating the water in the ice cans. Starting air for the "POC-1-A" unit is provided by an Ingersoll-Rand Type 15 vertical compressor, which maintains air at a suitable pressure in an associate receiver. This compressor is driven by a Novo gasoline engine.

Water for ice making is drawn from the city mains and is filtered before it is put into the 300-pound cans. City water is also used for cooling the oil-engine-ammonia unit. Harbor water is utilized to cool the Vogt ammonia condenser, which is set up outside the southern wall of the plant. Besides furnishing ice to fishermen and for packing fish for shipment inland, the plant occasionally supplies ice to re-ice the refrigerator cars. At times, when the local demand is highest in the summer season, some of the ice is sold for local consumption in Cape May. This is understandable when we recall that the permanent population of the town is 3,500, while the summer population amounts to 20,000.



Longitudinal section of Type "POC-1-A" oil-engine ammonia compressor such as is installed at Schellenger's Landing.

New Lighting System for Chilean Capital

By A. N. BAUDIN, JR.

SANTIAGO, the capital of the Republic of Chile, is soon to have a street-lighting installation that will be surpassed by none in point of excellence. The project includes the supplanting of the entire present system of gas and electric fixtures with up-to-the-minute equipment, laid out according to the latest practice.

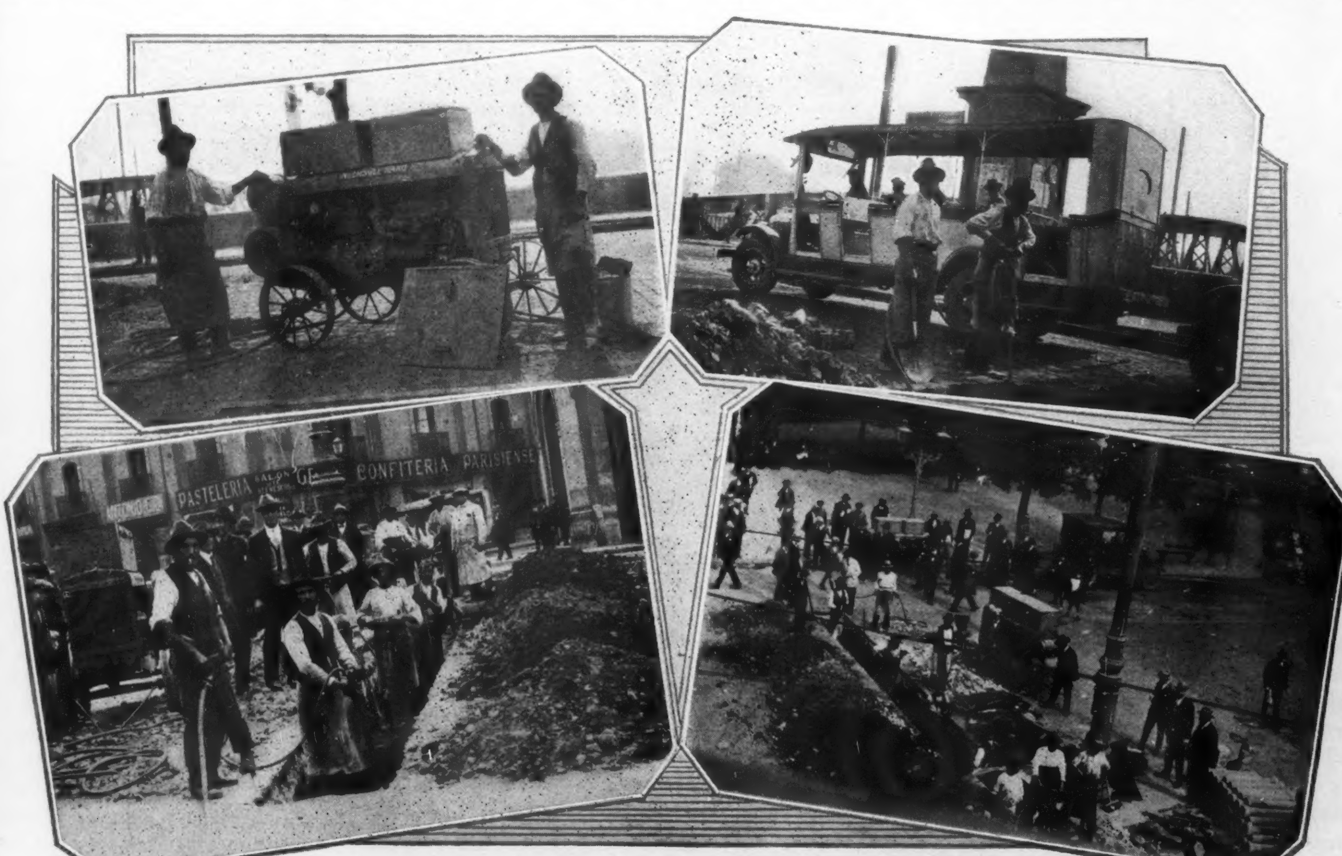
In addition to the regular street lighting, special illumination is to be provided at some of the most frequented public places. Among these are the *Plazuela de la Moneda*—on which front the presidential palace, the Government Building, and the Ministry of War Building—and the *Plaza de Armas,* the heart of Santiago, which is flanked by the archbishop's palace, the cathedral, the post office, and the Municipal Building. A total of 200 lamps, with an aggregate intensity of 100,000 candle power, will set this beautiful spot aglow by night. Another special arrangement of lights is specified for the *Cerro Santa Lucia,* one of the loveliest and most unique parks to be found anywhere in the world.

Because of its distinctive character, the *Cerro Santa Lucia* deserves a word in passing. Briefly, it is a hill of volcanic origin, roughly circular in cross section, some 190 feet in height, and located near the center of the city. Many years ago, Sr. Benjamin Vicuña Mackenna, a noted Chilean statesman and author, presented the site for a park to the city. Today it is laid out in winding paths, and planted with a profusion of trees and flowers. Many fountains and statues, a public auditorium, and a chapel, all add to the beauty of the spot; and the new system of lighting will go far towards making the park as popular at night as it is now in the daytime.

The equipment which is being installed consists of pressed-metal poles and "Novalux" fixtures; and the contract calls for more than 8,500 lamps. The lighting plant will operate on the constant-current-series system; and the current will be supplied by 50-kilowatt and 80-kilowatt constant-current transformers and individual lamp transformers. All the cable used is being furnished by the Callender Cable & Construction Company, of London.

The work is in the charge of Mr. P. M. Bennett, of the Callender Company, and his assistant, Mr. R. N. James. As the time in which to make the installation, as specified in the contract, is a relatively short one, it has been necessary to push operations as rapidly as possible. To this end, a battery of five portable compressors and numerous paving breakers, trench diggers, and "Jackhamers" were pressed into service; and with this pneumatic equipment, together with the skillful manner in which the work is organized, the job bids fair to be completed within the required time.

The construction work, itself, is varied, as the paving encountered in opening up trenches ranges all the way from concrete, asphalt, and composition, to cobble stones. These materials are readily broken up or pried loose by CC-35 paving breakers, each of which is provided with an assortment of tamping pads, chisels, and bull points that are inserted in the tool and used according to the nature of the work in hand. In some cases, 56-H trench diggers are employed to advantage. Compressed air is also proving a great time saver in removing large boulders found in the path of the trench diggers. These obstructions are quickly disposed of by drilling with BAR-33 "Jackhamers" and splitting with plugs and feathers. The cable ducts are laid under the sidewalks; and in this part of the work compressed air is mainly used in tamping the backfill in the trenches and in cutting street crossings in paving consisting of granite blocks laid on a base of concrete and cemented together.



Top, left—One of the 4¼x4-inch Type Twenty portable compressors and its operators. Each outfit is always ready for service, as the associate pneumatic tools and accessories are carried in the tool boxes mounted on the roof of the unit. Right—Using CC-35 paving breakers to remove granite blocks laid on a base of concrete.

Bottom, left—Trenches for the cable ducts were quickly dug by first disposing of the hard top surface with air-driven paving breakers and then using pneumatic clay diggers to do the actual work of excavating. Right—Cutting a big trench for five cable ducts across the "Plaza de Armas."

To give an idea of the rate of progress, the following figures may be taken as typical for trenches averaging 2 feet in width and dug with a CC-35 paving breaker, equipped with 1⅛-inch solid hexagon steels, drawing operating air from a 4¼x4-inch Type Twenty portable compressor. The figures represent average performances in square feet per hour:

Tamping backfill in trenches.......	463 sq. ft.
Cutting granite blocks laid on a concrete base	31 " "
Concrete pavement	43 " "
Asphalt	140 " "

Since the foregoing table was made, it has been found that the compressor, although of only 66-cubic-foot capacity, is capable of operating two CC-35's in tamping backfill because of the intermittent character of the work.

MAKING PHOTOGLASS BY MECHANICAL MEANS

FROM Belgium we learn of an interesting development in the art of photoglass making. According to *Commerce Reports,* all such glass was formerly mouth blown, and it was generally accepted that mechanically drawn glass could not be used for the purpose. But now comes the announcement that a factory at Jumet has already shipped to the United States 150 cases of photoglass produced by the Fourcault process of vertical drawing.

The quality of the product is said to be good; and, if it meets requirements, will probably mean the end of mouth-blown glass of this description. As a matter of fact, there seems to be a decided trend in the Belgian glass industry to do away with the time-honored methods and to substitute mechanical means wherever practicable.

PROTECTIVE MASK FOR THE AIR-SPRAY PAINTER

THE application of paint by means of the paint spray is finding increasing fields of usefulness, especially by railroads and in industrial establishments where some sort of painting is generally going on in the work of maintenance and repair or in the production of commodities. While the work of painting, whether done by hand or by the air spray, has always been classed as a "harmful occupation," the air spray makes it more necessary for men operating outfits of this kind to be properly safeguarded against the noxious fumes that are liberated. As painters working with brushes have generally disregarded health rules and warnings, the air spray, by insisting on the wearing of a mask, will actually make the calling a safer one.

Numerous types of masks have been devised for the painter, but most of them have been too heavy and bulky for comfort. Recently, however, a new type has been put on the market that is not only light but that serves the double purpose of keeping his clothes clean and of protecting him against the harmful fumes. The covering is made of heavy canvas and has two air openings in the top—one at each side. A 6x8-inch glass, set in a metal frame in the headpiece, enables the operator to see. The dislike on the part of painters to wear masks in the past may, perhaps, be overcome by providing them with a comfortable yet satisfactory covering that will not hamper them in their work.

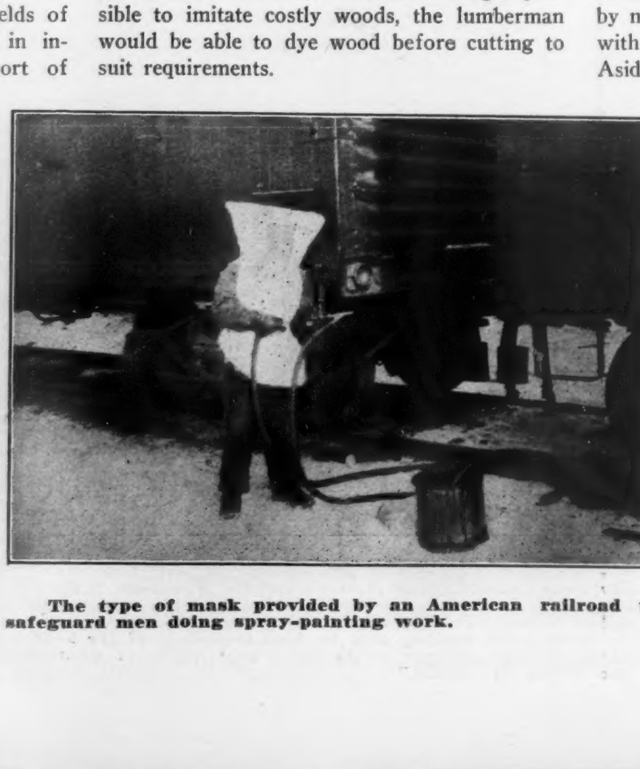
Courtesy, The Iron Age.
Feeding core paste through a nozzle by compressed air.

DYEING WOOD BEFORE CUTTING

IT is reported from Machias, Me., that a German scientist, Fritz von Behr, assisted by two students, has obtained some very novel and apparently valuable results by a process that enables him to color wood as it stands in the forest. He is said to have transformed beech into "rosewood" and yellow birch into "mahogany" so perfectly as to puzzle even lumber experts.

The flowing sap is charged with coloring matter that is thus distributed uniformly throughout the body of the growing tree. The pigment does not injure the fiber in the slightest; on the contrary, it has been found to act as a preservative. The change in color is effected in a few days; but the results are permanent.

It requires no stretch of the imagination to visualize what this would mean especially to the furniture industry. Besides making it possible to imitate costly woods, the lumberman would be able to dye wood before cutting to suit requirements.



The type of mask provided by an American railroad to safeguard men doing spray-painting work.

APPLYING CORE PASTE BY COMPRESSED AIR

IN want of something better, it has heretofore been the practice in foundries to apply core paste by hand. Now, however, the something better has apparently been supplied, and principally because of the availability of compressed air.

The device, the invention of G. H. Bowers, of Buffalo, N. Y., consists of an air-operated cylinder and plunger which force the paste through a nozzle attached to the end of a length of hose. The nozzle can be adjusted so as to control the flow of the paste. Any kind of core paste can be used by changing the size of the tip or nozzle and by regulating the air pressure accordingly. This flexibility also makes it possible for the operator to give the surface to be coated either a light or a heavy layer of paste.

The device can be utilized, as desired, either in the core room or on the molding floor; and, by means of a suitable connection, is linked up with the main air system of the establishment. Aside from saving much time, as compared with the hand method, it is claimed that by spreading core paste in the fashion described a smaller amount is actually required to do a satisfactory job.

In order to allow the largest cars to pass, the Hoosac Tunnel of the Boston & Maine Railroad is now undergoing enlargement. The work is simpler than it sounds, as it involves only the lowering of the roadbed by cutting away a layer of the underlying rock. As the passageway is double-tracked, traffic will not be interfered with—in short, by first sinking one track in its entirety the other track can be kept open for service. Operations are being carried on continuously with three 8-hour shifts.

Choice, Care, and Service Operation of Air-Driven Tools

PART I

By F. A. JIMERSON

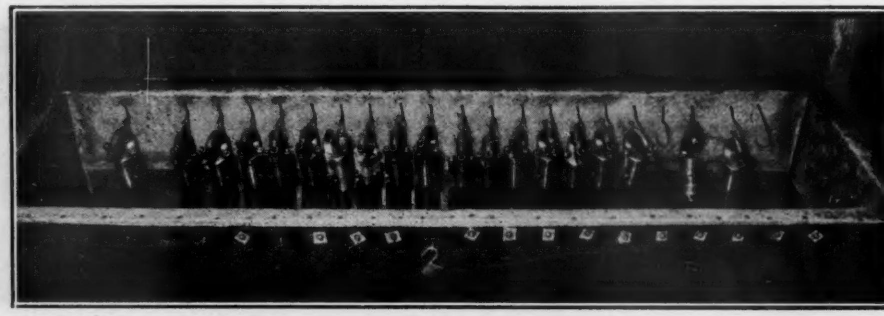
AIR-OPERATED tools are so generally used now in railroad and in other industrial shops that all executives are more or less familiar with their manifold applications. High-wage scales and keen competition have necessitated the adoption of all recognized labor-saving methods. Pneumatic tools are preëminently both labor-saving and time-saving devices. Relatively few men, however, have sufficient knowledge of these tools to select or to maintain them so as to realize maximum economies in service. The savings in time and in labor by the use of air-driven tools as compared with hand methods are so marked that the still greater savings possible through an intelligent study of the selection, application, and maintenance of these tools are frequently overlooked.

There is little available data published of a reliable character having to do with the power, the speed, and the air consumption of many of the pneumatic tools now on the market. There is little general knowledge among users of the ways and the means to keep pneumatic tools in good condition—not to mention a frequent lack of understanding how to tell when the tools are in condition to operate economically. One manufacturer has kept this in mind and has published general instructions on the use and the care of the air-driven tools made by him.* A thing deserving emphasis is the fact that too much or too little may be spent on repairs. Economical maintenance and maintenance for economical operation are not convertible terms—they represent two essentially different conditions. Only by making tests to determine power and air consumption can the true state of a tool and the extent of necessary repairs be ascertained.

The greatest single item of cost in the operation of pneumatic tools—aside from the charge for labor—is that for power, that is, compressed air. The cost for every 100 cubic feet of free air taken in at the compressor can be estimated rather closely for any plant, though this figure may vary widely in different plants. The cost depends on the pressure, the locality, the type of compressor, the piping layout, and the care with which the plant and especially the fittings are maintained. Leakage in piping and fittings may considerably increase the cost of operation, and therefore deserves careful consideration. In the average plant, roughly speaking, the cost of this leakage is estimated

Left—A close-quarter type of pneumatic drill reaming bolt holes in a locomotive frame.
Right—Testing a pneumatic drill with a Prony brake to determine the horsepower developed by the tool.
Bottom—Pneumatic drills tapping for stay bolts in making locomotive repairs.

at one cent per 100 cubic feet of air. Assuming that a compressor is economically adapted for the pressure and the volume required at a plant, it is good policy to go over the piping layout carefully and to make any alterations necessary to prevent leakage. Clean, dry air at a pressure of about 90 pounds is needed for the satisfactory operation of most pneumatic tools.



Pneumatic chippers suspended in a bath of kerosene to remove dirt and grit.

The importance of delivering dry air to the tools cannot be overemphasized. Otherwise serious losses in efficiency result, and these may readily represent more in dollars and cents than leaks in distributing lines. Clean air can be assured by taking in clean air at the compressor intake, using filters and screens if necessary, and by keeping the air piping in good condition. The intake should not be placed anywhere near ash dumps, or other dusty places, but should be well off the ground and above roof surfaces so that dust and cinders will not be swept into it. It should be protected from the rain and should not be located where moisture from exhaust steam will be drawn into it. Incidentally, the colder the intake air the greater the volumetric efficiency.

Dry air is more difficult to obtain. It is well to know the conditions which cause moisture in air lines and to know the trouble occasioned thereby. Air sucked into the compressor intake contains more or less moisture, depending on weather conditions. If the air is saturated, a slight drop in temperature will cause precipitation, like dew on a summer evening. One hundred cubic feet of air at atmospheric pressure may contain a given amount of moisture. If this volume of air is reduced sufficiently to raise the pressure to 90 pounds, and the temperature is not changed, this same air will occupy one-seventh of its original volume and will carry about one-seventh as much moisture. The balance will be precipitated as water. In a commercial plant this is about what happens, except that the air is heated during compression and the moisture is gradually precipitated as the air cools in the aftercooler, receiver, or pipe lines.

It is essential for the sake of economy that this moisture should not reach the tools. In drills and in motors it causes freezing and ice, which may seriously affect the power and the speed of the tool. In hammers, the freezing is not so noticeable, but in either case wet air is responsible for the rapid wearing of parts and for much corrosion and sticking of valves. The writer has observed exhaust temperatures as low as 40° F. below zero in the case of air drills actively engaged in the summertime. Drills that admit air throughout virtually the full stroke of the piston exhaust at a higher temperature than those that admit air throughout only a portion of the stroke and allow the air to expand behind the piston. The former may be expected to use upwards of 35 cubic feet of air per horsepower developed, whereas well-designed machines of the latter type frequently use less than 25 cubic feet per horsepower when operating at or above the maximum horsepower loads. The latter machines are somewhat more likely to freeze if moisture is present, though the exhaust from either type is usually well below the freezing point. It is evident that when all precautions are taken to remove moisture from the air delivered to pneumatic tools that economies will result.

It is advisable to provide aftercoolers near the compressors to cool the air somewhat below room temperature in order to precipitate the moisture. Aftercoolers should be equipped with suitable traps to keep them drained. Automatic traps should be provided rather than hand-controlled drain valves, which are very likely to be neglected. An aftercooler not properly drained is useless. As far as moisture removal is concerned, this applies also to intercoolers.

I-R sand rammer in use in a foundry.

Air lines should be of ample size to prevent undue pressure drop, and should be laid as carefully as steam-heating pipes. They should be pitched so as to drain with the flow of air; should be free from unnecessary turns; and should be provided at intervals with water legs or small receivers to collect water. These receivers should be automatically drained. Branch lines should be taken off the main line vertically and upward; and if these branches are long and sizable they, too, should be equipped with drains. Distributing headers are frequently used; and, where properly arranged, serve to collect a considerable amount of moisture which should be regularly drained. Hose lines should never be taken off the bottoms of headers or the low point of any air line or riser: drains should be placed there.

The writer recently inspected a rather large compressed-air installation where attention had been given to the location of the air intake; where aftercoolers were provided; and where the air lines were well laid out, and yet at times the air was very wet. Investigation revealed that no automatic traps were employed but that the units were drained periodically by hand. A good deal of the trouble was due to the use of distributing headers variously situated. These headers were really small receivers, about 1 foot in diameter by 3 feet long, laid horizontally on the shop floor. They were equipped with legs, and the hose-connection outlets were near the top; but as the headers had absolutely no provision for drainage they were continually filled with water up to the outlet level.

Moisture separators are coming into use. There are several on the market that give satisfactory results if properly installed and kept drained. It is the part of economy to locate them at intervals in the distributing mains. Small separators should be placed in branch lines and as close to the tools as possible. They will earn money day in and day out for those that utilize them. Another economy measure that is receiving a good bit of attention at present is the use of afterheaters, or reheaters. The Engineering Experimental Station of the University of Illinois has conducted extensive experiments with reheaters that are described in their Bulletin No. 130.

Reheating of compressed air is said to be one of the most effective means of converting heat into a form available for mechanical work. Where a number of tools are used continuously within a comparatively small area there can be no doubt as to the result. It is well known that the volume of compressed air increases proportionally with the temperature rise. Therefore, with reheated air, a greater volume becomes available for use. It is equally well known that the temperature of the air falls rapidly when expanding, as it does when

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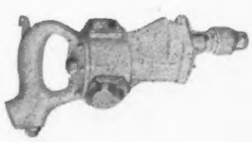
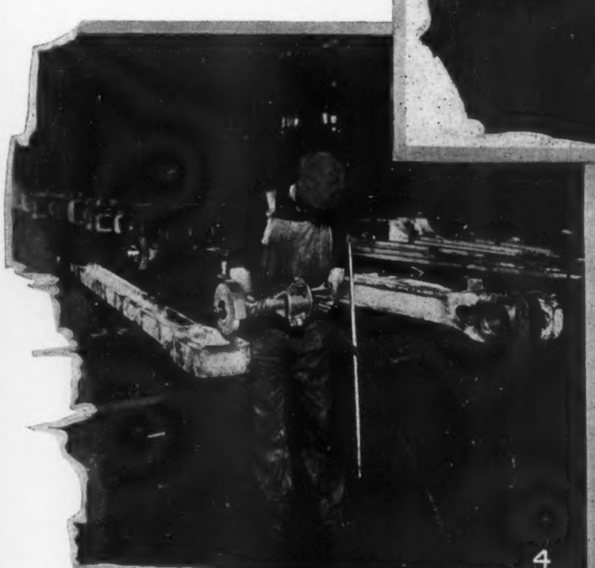
**General Instructions On the Use and Care of Ingersoll-Rand Pneumatic Tools. Service Information Sheet, C. I. No. 7, published by Ingersoll-Rand Company, 11 Broadway, New York City.*

SOME OF THE MANY USES OF AIR-DRIVEN TOOLS





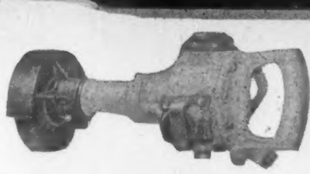
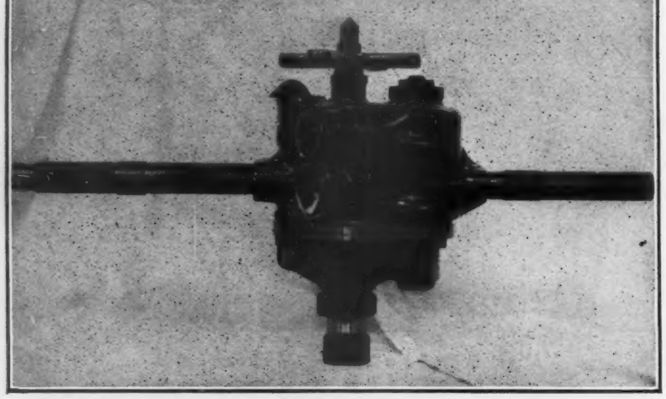
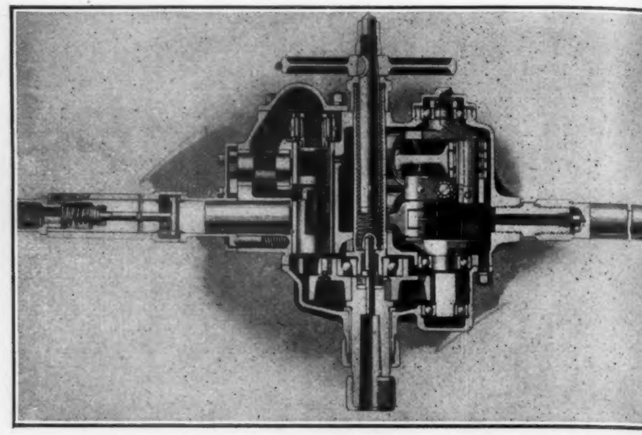


Fig. 1—A 3-cylinder pneumatic drill at work on an all-metal car.
Fig. 2—Pneumatic chipper at work in a shipyard on the flue sheet of a marine boiler.
Fig. 3—Double-gunning in driving rivets in a locomotive fire box.
Fig. 4—Pneumatic grinder dressing up ends of main rods in a locomotive repair shop.
Fig. 5—Air-driven woodborer in service in a railway-car repair shop.



Non-reversible pneumatic drill of the 4-cylinder type, suitable for reaming and tapping up to 1 inch diameter and capable of drilling holes up to 1¼ inches.



Sectional view of a modern 4-cylinder reversible pneumatic drill.

passing through pneumatic tools. It is this fall in temperature, with the consequent condensation of whatever moisture still remains in the air, that causes freezing. It is entirely practicable to reheat the air sufficiently to bring the exhaust temperature above the freezing point. With heavy lubricants, such as are used in pneumatic drills, the increase in temperature results in a marked increase in mechanical efficiency.

When we add to the foregoing economies the saving in man-hours due to the better operation of the tools, it seems unlikely that railroads and other large users of air-driven tools will long overlook the afterheater. Reheaters may be gas, oil, coal, or coke fired, or steam heated; but in any case they must be located close to the tools so that hose lines may be run directly to the tools. Air hose is a satisfactory heat insulator, and through it air may be delivered at a suitable temperature.

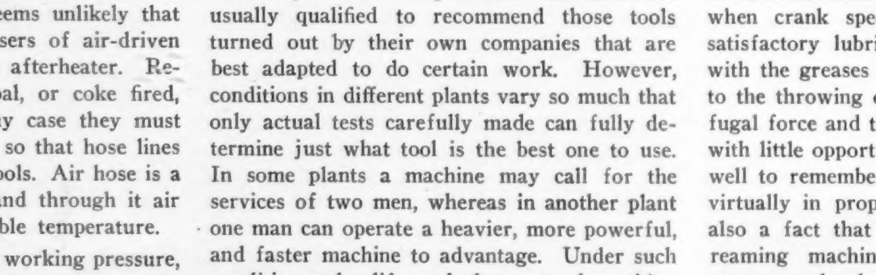
To maintain a satisfactory working pressure, without undue drop in pressure between the compressor and the tools, is not difficult with good compressor equipment and well-designed distributing lines. Frequently, however, there is a great loss in the lines. The writer recalls one case where two compressors were so connected to the distributing lines that all the air had to pass through a 1¼-inch pipe. This pipe would at times heat up to a dull red because of the high velocity of the air passing through it.

The selection of air-driven tools involves so many factors that it is impossible to lay down hard and fast rules. Where such tools are utilized, the major cost item in the case of most operations is, of course, that for labor. The man and the machine must be considered together; and ease of handling is essential. In this respect, light weight is desirable; but freedom from vibration, and ease of holding and ease of control are more important. Other things being equal, an operator will accomplish most with a tool that tires him least, though, as a matter of fact, day-work operators frequently fail to show any increase in output when supplied with tools that give superior performance in every way.

Tools must be selected to suit the work they are to perform. Experienced salesmen are usually qualified to recommend those tools turned out by their own companies that are best adapted to do certain work. However, conditions in different plants vary so much that only actual tests carefully made can fully determine just what tool is the best one to use. In some plants a machine may call for the services of two men, whereas in another plant one man can operate a heavier, more powerful, and faster machine to advantage. Under such conditions, the life and the cost of working tools, such as reamers and taps, must be considered. It is a case of taking into account the total cost of labor, air, tools, etc., per unit of work done. In this connection it may be well to call attention to the fact that it is usually better to operate a tool well up to its maximum capacity.

Pneumatic drilling and reaming machines, for example, are rarely injured by heavy loads even though they may be stalled frequently; but thousands of tools come to grief by reason of underloading, which permits excessive crank speeds. It is impossible to maintain light oils in these machines; and it is extremely difficult when crank speeds are excessive to secure satisfactory lubrication of crank-pin bearings with the greases commonly used. This is due to the throwing off of the lubricant by centrifugal force and to the rapid generation of heat with little opportunity for radiation. It is also well to remember that these machines use air virtually in proportion to their speeds. It is also a fact that most pneumatic drilling and reaming machines, unless equipped with a governor, develop their maximum power when running at approximately half their free speed and when operating at a load somewhat more than half their stalling load. The air consumption per unit of work done— that is, per horsepower—will be lowest at a load well up towards the stalling point. This will increase somewhat at the maximum horsepower point, and very rapidly at lighter loads permitting higher speeds. One manufacturer has provided a governor to limit the speeds of his machines as a protection against damage and to save air.

In selecting pneumatic tools it is well to consider that they are relatively very small, compact, and light units and that they are designed to produce a considerable



Loosening or picking hard ground with a pneumatic digger.

Ramming sand in a mold with pneumatic rammers.

amount of power. In order to accomplish these results at all, speeds must be high and the individual parts must be very light, with the result that working stresses set up in the materials used in the construction of the tools are frequently much higher than would be considered good engineering in other fields of design. In consequence, materials must be carefully selected and heat treated. The more progressive manufacturers maintain laboratories for research and inspection work to improve and to maintain the quality of their product.

With these points in view, and with a knowledge of the conditions under which the tools should be used, it is reasonable to expect that they will require frequent overhauling and repairing. In selecting tools, therefore, the cost of repairs—from the standpoints of labor and of parts—is a point to be given weight.

Let us first consider drilling and reaming machines. For medium and for heavy service most modern machines are of the 4-cylinder V-type, with double-throw cranks. The general adoption of this type is undoubtedly due to the compact, symmetrical arrangement with the feed screw in the V between the cylinders and with the overall length determined by the length of the feed and by the Morse taper socket used. The principal troubles with these machines are caused by failure of the crank or connecting rods. Two connecting rods operate on each crank pin, and a toggle form of connection is common between the piston and the crank pin. Many designs have been tried with more or less success. In some of them the connecting rod proper is integral with the piston and cannot be renewed separately. A ball-and-socket connection is common, but at present the tendency is to use a wrist pin. The best practice is to have the piston, pin, and connecting rod renewable independently. In all designs using toggles, one or both connecting rods bear directly on the crank pin, both of which are hardened and ground. Heating or wear is likely to ruin them.

Until recently, one manufacturer has used a roller-bearing construction on the crank pins. In this case, the connecting rods were solid and were made sufficiently large to be passed over the throws of the crank—the rollers being put in one by one. No retainer was used. The principal difficulties with this construction were the weight of the bearing assembly and the inability to provide suitable counterweights. The crank pin formed the inner raceway for the rollers; and failure of the bearing was likely to ruin the crank. Other manufacturers have tried ball bearings; but, in general, they have not been successful owing to the peculiar forces set up and the inability to use bearings of sufficient size because of space limitations. One foreign maker has attempted to use four very small standard ball bearings on each crank pin with a built-up crank. That construction is too light to insure durability.

One well-known manufacturer has recently brought out a crank and a connecting-rod construction deserving careful consideration. A heavy built-up crank is used, permitting solid-type connecting rods; and all wearing parts are independently renewable. The crank pin is provided with a hardened and ground bushing which is fixed on the pin to receive the wear. The connecting rods run on a hardened and ground steel bushing which "floats" inside the rods and on the fixed crank-pin sleeve. With this construction it is rarely necessary to renew more than the fixed sleeve and the floating bushing, as the pistons can be renewed independently of the connecting rods.

Another source of considerable expense in the maintenance and in the operation of drilling and reaming machines is the common practice of boring the cylinders directly in the main casing. The pistons are not provided with rings—for good reasons, and wear of the cylinders causes an increase in the air consumption of the machine. Denting of the case through misuse or accident is likely to cause a high repair bill. Machines should be specified that have readily renewable cylinders.

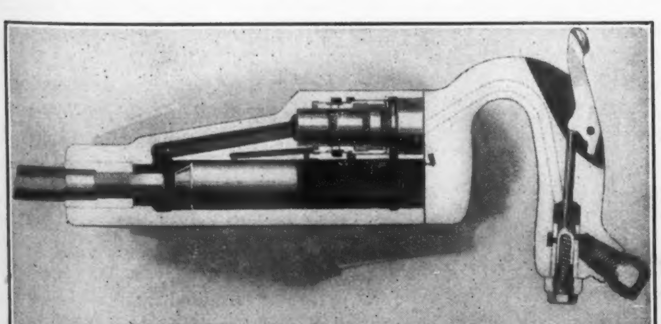
In selecting drilling and reaming machines it is well to ascertain the following:

Is the machine relatively free from vibration and easy to handle and to control?

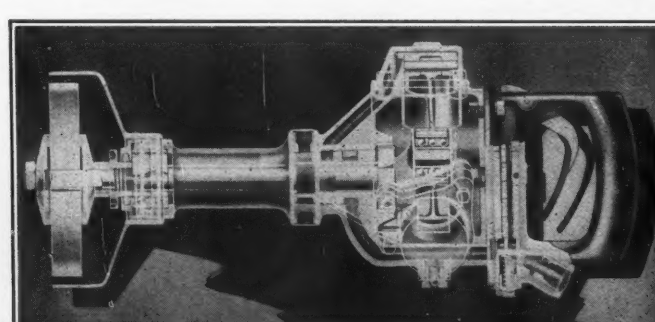
Is the machine adapted for the work—that is, will it operate most of the time at a speed somewhat less than half its free speed? If not, the air consumption will be unnecessarily high. From the standpoint of air consumption and maintenance it is better to provide a machine that will stall occasionally than one with a considerable excess of power.

Does the work require a reversible machine, or will a non-reversible machine be suitable? The air consumption per unit of work is usually 20 per cent. higher with a reversible machine, and it is somewhat heavier and has a more complicated throttle.

Can the machine be kept in continuous and economical working condition at reasonable cost? That is, are the following enumerated parts interchangeable and readily accessible for



Sectional view of a chipping and calking hammer having the valve offset from the piston bore.



Phantom view of a portable pneumatic grinder illustrating the arrangement of motor, crank shaft, spindle, and grinding wheel.

repairs so that the labor item may be kept as low as possible? For instance, cylinders, pistons, connecting rods, crank-pin wearing surfaces, crank pinion, main valve, and bushing.

Is the air consumption per horsepower low throughout the working range of speeds, and can it be kept low for the life of the machine?

(To be concluded)

OIL PREVENTS DRIFTING OF DESERT SANDS

OUT West, in the sand-hill country of California and Oregon, highway engineers have for years been waging a losing battle with the sands in an effort to prevent long stretches of roads from being buried afresh after each windstorm. Thousands of dollars have been spent in clearing the roads, only to have them covered again by drifting sands.

In planning a new highway across the sand-hill section of Imperial County, the engineers of the California Highway Commission decided to try oil for slope and shoulder protection. The idea was not original with them, as the practice of oiling sandy stretches is attributed to certain railroads; and the Oregon Highway Department tried oiling large areas on the windward side of highways, slopes, etc., as far back as 1920.

To determine the kind of oil best for their needs, as well as the quantity required to form a homogeneous mass, the Testing and Research Department of the California Highway Commission undertook a series of experiments with desert sand and different oils having asphalt contents up to 65 per cent. In making the tests, the sand was placed in pans, having an area of 1 square foot; and the oil was applied in a finely divided spray with air at a pressure of 50 pounds.

The tests revealed that an oil containing from 40 to 50 per cent. asphalt is best suited for the work: it will hold the sand particles together in a heavy mat after the more volatile oils have evaporated. Oil of this kind will readily penetrate the sand and can be applied cold. Repeated trials have shown that it is necessary to use not less than half a gallon of oil per square yard of area to be covered. As a result of this laboratory work, the shoulders and the slopes of six miles of highway, now being run across the sand dunes of Imperial County, are thus to be oiled to keep the road open to traffic.

According to a compilation made by the American Telephone & Telegraph Company, the total capital invested in telephone plants in the United States at the end of the first quarter of 1926 amounted to \$3,095,000,000. By April of the present year there were 17,165,631 telephones in service throughout the country—representing about 62 per cent. of all the instruments in use in the world. To be more explicit, there are 14.2 telephones available here for every 100 persons; and it has been estimated that the average American makes 191 calls annually as against 23 calls checked against the average Britisher.

BOSTON POST OFFICE AGAIN USES PNEUMATIC TUBES

AFTER years of disuse, the United States Post Office in Boston has restored to service its pneumatic tubes for the dispatch of mail matter throughout a system of underground conduits having a total length of substantially seven miles. These tubes are made up of five miles of 10-inch piping and two miles of 8-inch piping, so arranged that they link the principal units of the Boston Post Office. Before the installation was closed it provided a rapid means for the transmittal of letter mail among the associated stations; and the system proved its value to the public day in and day out and especially at times when conditions made traffic on the streets difficult and slow.

In an official report, made three years ago by a special congressional commission, is the following significant statement: "So far as the congested area is concerned, the pneumatic tubes may be regarded as the ideal method for transferring letter mail, but the tubes did more than serve to expedite the mails within the area indicated. As originally operated, the tubes not only connected the North and the South Station with the general office, all in the congested area, but they extended east from South Station to the Essex Station, at which points they forked, one branch extending south and west to the former location of the Copley Square Station, and the other branch south to Station A, thence to Roxbury Station, and thence to Upham Corner Station."

Furthermore, we read from the same hearing: "In winter the efficiency of the underground tubes as contrasted with surface travel by motor trucks is especially marked. During the period of heavy storms last winter street traffic was often entirely blocked for a time and seriously retarded for days. It was then common to see motor trucks loaded with mail in the streets of the business district helplessly stalled. Regardless of weather in such times as these the pneumatic tube carriers go smoothly on their way at 30 miles an hour."

The resumption of the pneumatic-tube service in Boston will prove a boon to all concerned, because, in addition to handling letters expeditiously, the tubes make it possible to deliver letters to outgoing trains when received at the general post office only five minutes before those trains depart.

© International Photo, Boston.

Honorable William Butler, United States Senator from Massachusetts, pressing the button that reopened to service, after some years of idleness, the pneumatic mail tubes in Boston. Senator Butler stands just above the right-hand tube watching Mr. Emerson, President of the Pneumatic Tube System, place a mail cylinder in the left-hand tube.

MODERN MASONS OUTDONE BY ANCIENTS

NEW quays, extending for more than three miles along the waterfront of the Port of Algiers, in North Africa, are being built of concrete blocks each 43 feet in length and weighing 450 tons. To facilitate matters, these blocks are formed on floating pontoons, from whence they are swung into position by means of a floating crane.

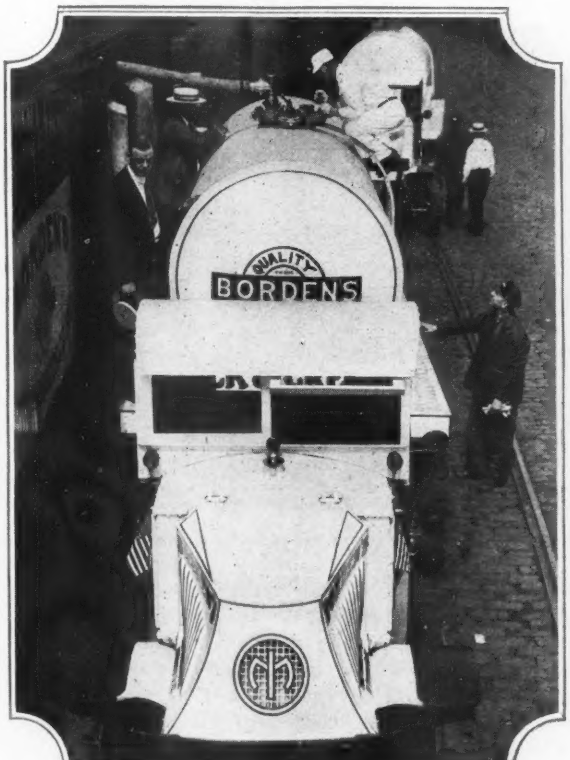
The *Stone Trades Journal,* in commenting on this great work, asserts that the ancients, with the facilities at their disposal, achieved far greater tasks than modern engineers. Mention is made of the huge stones—three times as big as the concrete blocks used on this Algerian job—employed in erecting the wall of the Acropolis at Baalbek, in Syria. Those stones were so perfectly squared and so accurately placed that a knife blade could not be inserted in the joints. One of the stones, still lying in the quarry where it was cut thousands of years ago, weighs 1,500 tons.

New Era in Milk Transportation

By THE STAFF

THE 40-quart milk can—long the means commonly employed in shipping milk from country stations to city terminals—is likely to be superseded in the near future by tank cars capable of carrying 6,000 gallons of milk at a time. At least, such seems the likely prospect if the change of procedure recently introduced by the Borden's Farm Products Company, Inc., wins the recognition it deserves from the dairy industry generally.

If one stops to think of it, it should be evident that many thousands of 40-quart containers enter our large cities daily in order to provide young and old with the fresh milk demanded. Each of these containers is necessarily handled a number of times from the moment it is filled until it is emptied; and, in one way or another, this invites losses and possibly contamination. Furthermore, each of these cans must be carefully washed and sterilized to make it safe and fit for the service expected of it. Quite apart from the expense incidental to handling these cans and to maintaining them in a suitable condition, there is the ever-present menace to public health offered by neglect.



The refrigerator car delivering milk, under the impulse of compressed air, to one of the tank trucks. It takes just seven minutes to load one of these trucks with 2,000 gallons of milk.

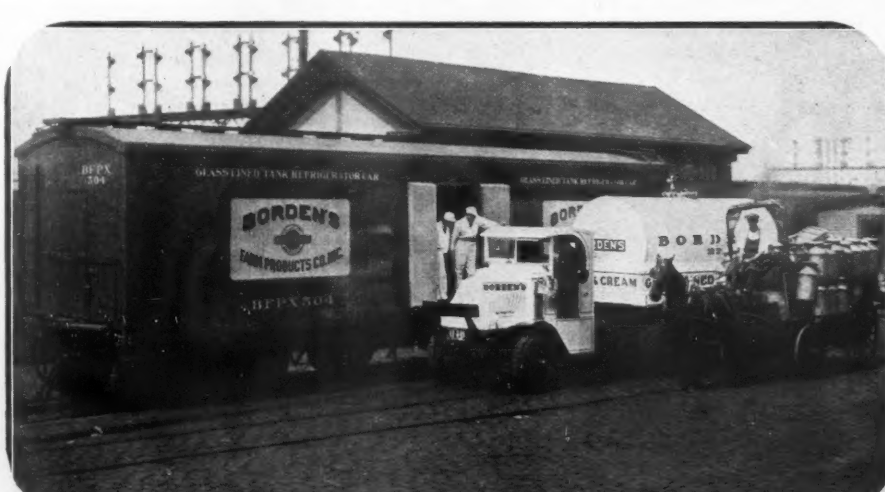
Obviously, there has been room for improvement in the means employed for transporting bulk milk—that is, in getting the milk from the country to the city. And it has been equally desirable that this transfer should be effected with all possible dispatch in order to insure the freshness of the commodity on reaching the ultimate consumer. Therefore, one wide-awake dairy concern in Philadelphia called into being a few years ago a fleet of speedy tank trucks—each equipped with a glass-lined, insulated tank capable of holding 1,440 gallons of milk. Some of the trucks have a run of substantially 70 miles between the rural receiving station and the main plant in Philadelphia.

In order to safeguard the transfer of the milk from the trucks to the storage tanks, at the end of the runs, the Philadelphia concern has used compressed air rather than pumps to force the milk from the glass-lined tanks to the second story of the Philadelphia establishment. As a further hygienic precaution, this impulse air is sterilized. So far so good. Now let us see how the Borden's Farm Products Company, Inc., has gone one step farther in looking after the health and in providing for the comfort of its patrons in the Metropolis.

This enterprising concern has recently put into service between Apulia, N. Y., and the Metropolis—a distance of 250 miles—a special refrigerator car containing two glass-lined tanks, each of which is large enough to hold 12,000 quarts. In other words, the car carries enough milk in its two glass-lined, sterilized containers to fill 600 of the ordinary 40-quart tin cans. Thus, milk gathered from the contented herds of remote pastures is transported to New York from Apulia in the relatively short running time of ten hours—reaching its destination without handling en route and sealed against possibly dangerous intrusive germs.

Other cars of the same type will shortly be added to the service so initiated. These vehicles are outwardly similar to the well-known Merchants' Dispatch refrigerator cars, built by the Merchants' Dispatch Refrigerator Company, of Rochester, N. Y., but internally they differ from the rest of these familiar carriers in a number of particulars. We are indebted to the Borden's Farm Products Company, Inc., for the following descriptive details:

The car is 45½ feet long; and the outer walls are of wood construction insulated with 2 inches of cork wood. The car equipment includes a ventilator; a complete electric lighting system that provides illumination for the inside of the two glass-lined tanks and for a workroom; mechanical agitators for stirring the milk before removing it from the tanks; and compressors that furnish the air required to force the milk out of the tanks. Each glass-lined tank is 13 feet long and 6½ feet in diameter, and is built of ⅜-inch steel plate insulated on the outside first with 2 inches of cork board and then with sheet steel. As a matter of fact, both the car and the tanks are so well insulated that, without the use of ice, the temperature of the milk will not rise even 1° F. during the trip from Apulia to Hoboken.

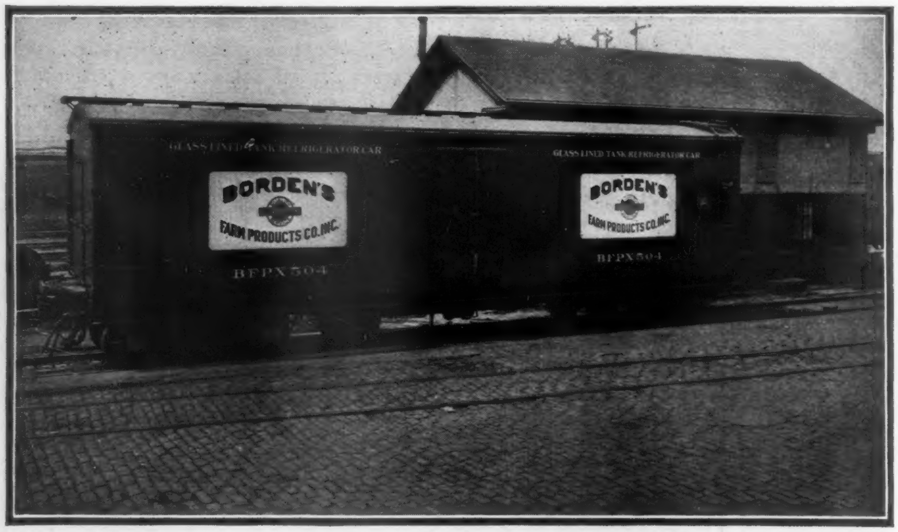


A matter of contrasts: the glass-lined tank car and the glass-lined tank truck with a horse-drawn cart standing by loaded with ordinary 40-quart cans.

Bulk milk drawn from about 120 separate farms in Apulia and vicinity is delivered to the local Borden plant. But before it is put in the refrigerator car it is first weighed, inspected, sampled, and passed over a cooler — where it is chilled to a temperature of 36° F.—and thence, by way of sanitary piping, allowed to flow into the insulated tanks aboard the car. Only Grade

"A" milk for pasteurizing is handled at this plant.

On arriving at the Hoboken terminal, the milk is thoroughly stirred by the mechanical agitators for the purpose of distributing the butter-fat content throughout the mass. Then, by means of filtered air, supplied by the compressors installed in the car, it is forced through sterilized piping into insulated, glass-lined tanks, of 2,000 gallons capacity, mounted on motor trucks. In this way the milk is transported to the company's pasteurizing plant, which is located in Brooklyn, N. Y. There, again, the milk is fed from the tank trucks through sanitary piping into glass-lined storage tanks, whence it finally reaches the bottling department. In short, the milk is in contact with glass throughout well-nigh its entire journey from the farms, 250 miles away from the city, to the consumer. The tanks, both in the cars and on the trucks, are thoroughly scrubbed and sterilized with live steam every day. Considered only from the sanitary standpoint—as the health of a community depends to a great extent on a supply of fresh, pure milk—the tank car and the tank truck will probably supplant the 40-quart can for the long-distance haulage of milk.



The first of the novel type of refrigerator tank cars to be used for the carriage of bulk milk.

©N. Y. Central Lines Magazine.

One of five milk stations through which the New York Central Railroad delivers 45 per cent. of the city's supply in the time-honored way.

DETERMINING AGE OF ROCKS AND MINERALS

DURING the last two decades, increased knowledge of the phenomena of radioactivity, together with analyses of minerals, has given us, so we are told by the United States Geological Survey, a new measuring stick for determining the age of minerals and rocks. The work by this new method is little more than begun, but enough has been accomplished to indicate the age of the globe as computable in hundreds of millions of years rather than in tens of millions, as has often been the case heretofore. Somewhat as the hardening of the bones indicates the age of a human being, so the accumulations of helium and of lead in uranium and thorium minerals, respectively, indicate their ages, but on a scale whose units are millions of years. The criterion is based on the fact that helium and lead are the end products of the radioactive decay of the elements uranium and thorium; and the age of the rock is computed from the rate of such decay and the quantities of these sub stances contained in the rock.

Time relations have always been of major interest in geology. Both practical and theoretical geologists need to know in the study of rocks and minerals which were formed earlier and which came later. The mere observation of relative position was for a long time the only guide. Then came correlation by means of fossils of extinct animals; and, finally, attempts have been made to estimate the length of time required to deposit the sedimentary strata or to cut gorges, or the time required for sediments to shrink, for the earth to cool, etc.

The chemical laboratory of the Geological Survey has furnished many of the analyses by which the age of minerals and of rocks may be computed from the content of helium and lead. The making of analyses useful for this purpose is a complex process. Hillebrand early set the standard; and even he, in his extended work on uraninites, failed to discover that part of the "nitrogen" gas he measured was helium. In the popular conception, an analysis of a mineral or a rock is perhaps a simple and quick operation like an assay for gold; but a mineral analysis may consume weeks of time and study—in fact, the combinations of elements in the rarer minerals are so variable that their complete analysis may require months. Few standard methods of procedure are available as guides. For the purpose of determining the age of minerals, however, only the percentages of uranium, thorium, helium, and lead seem to be absolutely necessary at present; and when more experience has been gained in their estimation the time required for the analytical work may be shortened considerably. The minerals to be analyzed for age determinations must be carefully selected with regard to freshness and geologic sequence, if that can be established.

This method of determining the age of minerals and rocks has been studied rather extensively abroad, particularly in England and in Austria. In this country, the problem has recently been taken up under the auspices of the National Research Council through the coöperation of a number of scientists and various institutions, including the Geological Survey, the Geophysical Laboratory, Harvard University, and others. A table of minerals, showing their geologic horizons and their ages, computed by this method has been prepared for the International Critical Tables of Constants, which are being published under the auspices of the National Academy of Sciences and the National Research Council.

As this method of investigation is comparatively new, the accumulation of further data is greatly needed; and the study of minerals that may serve as age indicators is being continued in the chemical laboratory of the Geological Survey. Subsidiary to the problems of analysis are the problems of separating, for the purpose of analysis, a sufficient quantity of these particular minerals from a large mass of granite, and of accounting for their rather general occurrence in pegmatites; and also the problem of the correlation of determinations of age based on laws of radioactive decay with those made in other ways.

Removing Submarine Ledges

Methods Employed in Locating, Drilling, Blasting, and Clearing Away Obstructions of This Kind

By JOHN R. KENNERLY

JUST off the shore from the ledge of rock on which, according to tradition, Roger Conant and his followers landed three centuries ago to establish the historic colony of Naumkeag—long since known as Salem of witchcraft fame—there are other ledges hidden below the smooth surface of the harbor. These ledges, which have served no such honored purpose, have been a menace to navigation for years.

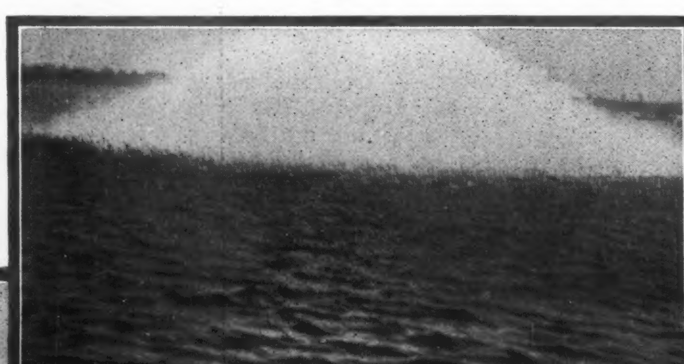
Modern commerce has demanded the removal of these obstructions, and this work is now being done by craft equipped for the breaking up and the removal of ledge rock down to a depth of 35 feet below the surface of the water. This ledge removal is included in a project that calls for the improvement of the harbor at Beverly, Mass., which is located just north of Salem and about 20 miles north of Boston on the Boston & Maine Railroad. Here, where the Danvers River enters Massachusetts Bay, is a well-sheltered natural harbor.

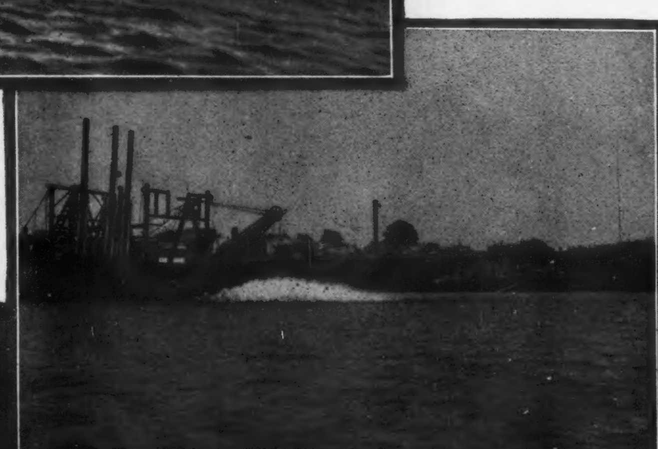
Colonists from Salem crossed the river and settled Beverly in 1630. The earliest industry was fishing. Long trips were made to the fishing grounds; and nearly all the men spent their summers at this occupation. The shoe industry was established in Beverly in those far off days. At that time, the work was done in little shops in every yard—the men making shoes in the winter months when home from their fishing trips. It was from these small beginnings that the shoe business grew until today it is the main industry in that section of the country. On the waterfront, the Gulf Refining Company and The New England Fuel & Transportation Company have provided terminal facilities and docks for unloading steamers and reshipping their products by rail and motor truck throughout northern New England. The harbor also accommodates the shipping of local gas, coal, and lumber firms.

Before the present improvements were undertaken, the prevailing depth of the channel was 18 feet at mean low tide, with a 9-foot rise. As many of the steamers making Beverly a port of call require up to 24 feet of water, it was not infrequently necessary for them to wait for high tide on entering and on leaving the harbor. This often caused a delay of 24 hours and more on one trip. Considering the fact that the cost of operating these vessels amounts to as much as $60 per hour, it can be appreciated that these delays are expensive. There was also a sharp bend in the channel which large ships found difficult to navigate and undoubtedly hampered the development of the port. The improvements in hand include the straightening of this channel by cutting across a sand bar and by deepening to a grade of 24 feet below mean low water.

A preliminary survey was made which included soundings covering the entire harbor and wash borings, where necessary, in the vicinity of the proposed channel. Then channel lines were determined, taking into consideration natural advantages and avoiding obstacles wherever this could be done. The first step in the operations was to remove as much as possible of the overlying material—such as clay, gravel, etc., by means of regular types of dredges. The contract for this part of the work was completed in 1924. With the ledges thus exposed, a survey was then made to locate and to determine the amount of rock to be removed so as to arrive at a basis on which to solicit bids for the contract. This survey consisted of making borings in those areas where ledges were found after dredging.

For this survey, intersecting sets of shore ranges were employed to establish the positions of the borings. To those not familiar with the term "range," as used in hydrographic work, it simply expresses a means by which a line, established on shore, can be extended out upon a water area. Perpendiculars, usually pieces of 2x4-inch lumber carrying some distinguishing flag or banner, are erected at two points some distance apart on the shore or flats on an established line. In this case, a small 50x12-foot scow, from which the borings were made, was anchored at a point offshore where the two perpendiculars or ranges were directly in line with it and where the position of the scow in relation to that line was known. With another set of ranges intersecting the scow at about right angles its position along the first line was made known. Thus, the whole ledge area was covered with a network of these intersecting ranges; and then, with the scow held on line with anchors,





Top—Close-up of surface disturbance made by a submarine blast.
Left—Tug, floating blacksmith shop, drill boat, and dredge at work.
Right—Blasting a submarine ledge in water ranging from 24 to 30 feet in depth.

Left—Broken rock raised from blasted ledge and deposited in dump scow for removal.
Right—Dipper of the big dredge coming up with a load of broken rock.

it was a fairly easy thing to determine from aboard the scow positions along the lines between ranges by taking measurements from the range intersections.

As an accurate survey was desired, the lines were plotted 6 feet apart, while the borings, on each line, were put down at 2-foot intervals. Inasmuch as the ledges had been cleaned by dredging, these borings were made with a pike pole—a wooden pole, 3 inches in diameter and approximately 40 feet long, with a tapered steel point about 6 feet in length. In most instances, it was a simple matter to drive the sharp point through the mud on to the rock; to record the depth at which rock was found; and to move the pole 2 feet along the side of the scow to make the next boring. At each setting of the scow 50 borings were made, covering an area of 600 square feet.

In plotting this survey, a model of the scow was used. This model, which was cut from heavy paper and was made to the scale of the plan, simplified the work considerably. Later, with a similar model of the drill boat, placed on the plan to indicate the position occupied by the drill boat as operations progressed, it was comparatively easy to keep records of the position of the drill boat, of the area drilled and blasted, etc.

The contract for the rock removal was awarded to the Bridgeport Dredge & Dock Company, of Bridgeport, Conn. In this work they are employing their Drill Boat No. 3 and Dredge No. 2, together with a tug, a lighter, scows, etc. The drill boat is 92 feet long by 32 feet wide, and is equipped with four giant legs or "spuds," each 50 feet long. These spuds, when lowered to the bottom, hold the craft firmly in position, thus eliminating the use of anchors. This drill boat was especially designed and built in the yards of the Bridgeport Dredge & Dock Company, under the supervision of George W. Sunderlin, treasurer of the company. To furnish the necessary air for the drills there is a compressor plant aboard.

Drilling is carried on from three drill frames mounted in a row across the bow of the drill boat. These frames overhang the end of the vessel about a foot and each can be moved several feet—thus enabling the drills to be set over any point beneath this end of the craft.

Each drilling outfit is mounted on a long, square pole, commonly called a "drill spud." This spud is set vertically in the drill frame and can be lowered until the iron shoe, attached to its lowermost end, rests on the harbor bottom while the upper end of the spud is held rigid in the drill frame. This is the position of the spud while the holes are being drilled and loaded with dynamite.

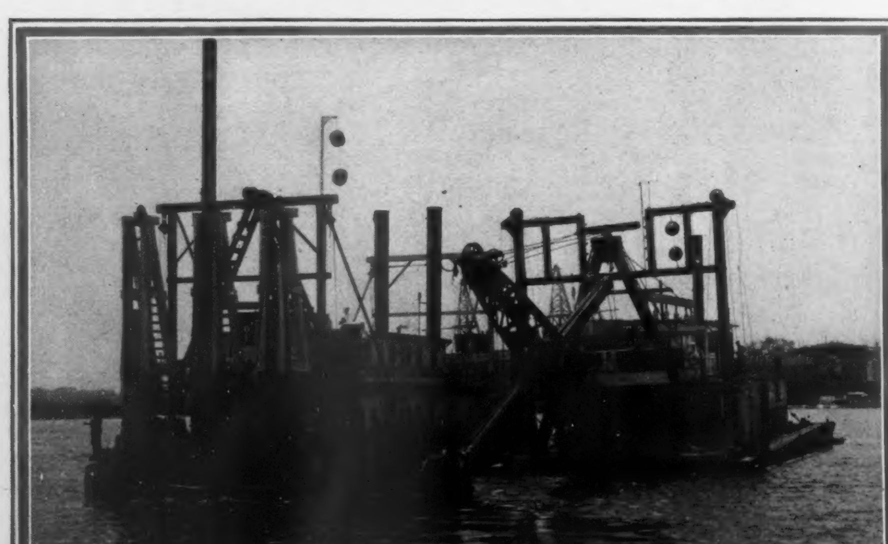
The air hammers used are of the Ingersoll-Rand "X-71" type fitted with a special backing plate grooved to slide on rails on the drill spuds. Each air hammer is raised and lowered on the slides with 1-ton chain falls which hang from the top of the drill spud.

The drill steels are $1\frac{1}{4}$ inches in diameter and from 25 to 42 feet long so as to allow the hammer to operate at a convenient level above the surface—the length of the steels required depending on the elevation of the rock and the depth of the water. To keep the drill steels in condition for cutting, a blacksmith shop equipped with a pneumatic sharpener has been mounted on a scow that is moored close to the drill boat.

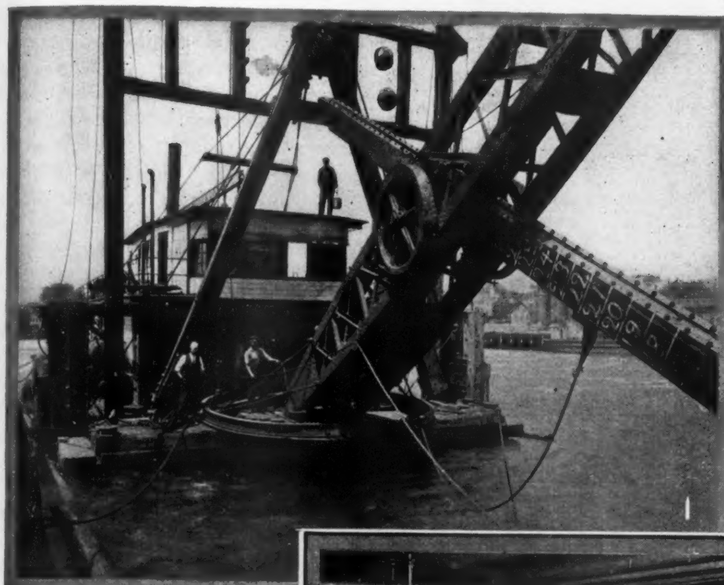
The rock drilling is done from inside a casing or shield, which is bolted to the lower end of the drill spud and centered under the air hammer. This casing is just a piece of heavy 4-inch pipe, about 12 feet long, the lower end of which is a few feet below the spud shoe so that the weight of the spud will rest on the pipe and assist in forcing it through any clay or gravel overlying the rock. It should be evident that the casing is essential to spotting and to holding the drill at the desired point. Besides, it keeps gravel and other material from filling the hole, and is a convenient guide for locating the hole when changing drill steels or when loading. Before drilling is started, an air line is lowered into the casing to wash out all loose material and to help the pipe find a footing on the rock to be drilled.

The practice is to drill six holes during each setting of the drill boat—that is, two holes with each drill. The holes are spaced about 5 feet apart. As soon as a hole is drilled it is loaded before the drill spud is raised and the frame moved. Loading is facilitated by a piece of light sheet-iron tubing that is slightly smaller in diameter than the hole and long enough to enter the hole from the drill platform. The dynamite is dropped into the tube and pushed to the bottom of the hole with a long wooden ramrod.

When the six holes are loaded, the drillboat is hauled back anywhere from 50 to 70 feet and all the holes fired simultaneously. The drill boat is then moved 5 feet ahead of its former position, and drilling is resumed. In this manner the whole ledge area is progressively drilled and blasted—the rock being broken into pieces that can be picked up readily with a regular dipper dredge.



Drill boat and dredge at work in Beverly Harbor, Mass., removing submarine rock.



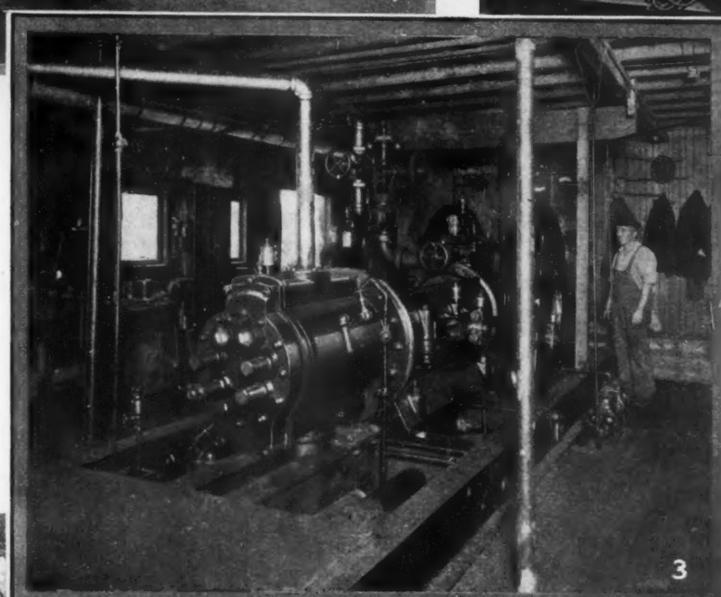


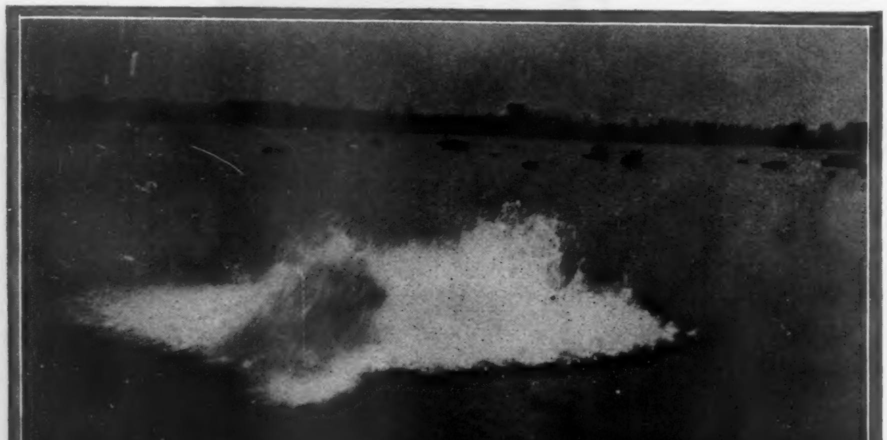
Fig. 1—Marion-Osgood, 4-yard dipper dredge raising broken rock and loading it into dump scows.

Fig. 2—Lower parts of the "X-71" drill rigs, used aboard the drill boat, showing the pipes through which the drill steels operate.

Fig. 3—The Ingersoll-Rand steam-driven compressor, on the drill boat, which supplies operating air to the "X-71" drills.

Fig. 4—Hollow, round, 1¼-inch drill steels, having a maximum length of 42 feet, are used in attacking the rock from the drill boat.

Fig. 5—Three "X-71" drill rigs, with their crews standing by, ready to begin work on the submerged rock. Captain Peter Peterson at upper left, and Superintendent Jack Toole, in his shirt sleeves, at upper right.



Water blown upward by explosive used to blast rock at a depth of 30 feet.

To shift the drill boat—which has no motive power—both after drilling and blasting, the dredge is placed alongside but somewhat astern of it. The dredge has its spuds lowered to hold it in position. The drill boat's spuds are then raised; and, with the aid of lines from capstans on the dredge, the drill boat is hauled astern until it is abreast of the dredge.

After the dredge has covered an area in removing the broken rock, examinations as to the condition of the channel are made by sweeping. Sweeping is commonly done in connection with dredging operations to locate shoals; and a brief description of what is involved might be of interest. According to conditions encountered, various methods and equipment are used in this work, but the method here described is both simple and efficient.

The sweeping party consists of a sextant observer—usually the chief, two sweep tenders, two boatmen, a tide observer, and a recorder. The equipment includes a piece of 2½x2½-inch T-iron, 25 feet long, called the "sweep." This device is so suspended from two chains, which are fastened about 4 feet in from each end of the sweep, that the top of the T rests on the bottom. The chains are gaged in feet to indicate the depth at which the sweep is set when in use; and the sweep is hung from a 20-foot rowboat—one chain being secured at the bow end and the other at the stern. Each chain runs over a roller fitted in the rail of the boat on one side—the links falling over a pin in the rail on the opposite side.

This outfit allows the sweep tenders—one in each end of the boat—to set the sweep at the required depth. Carrying a part of the weight of the sweep in his hand, an experienced man can tell instantly when the T-iron strikes an obstruction, because the chain acts as a good conductor of even a slight jar. In fact, when the sweep strikes rock, the ring of the metal can be plainly heard aboard the boat.

In sweeping, the tidal currents are made use of in moving the boat broadside along the channel, although at times, when the tidal currents are weak or when winds tend to offset the force of the tides, it is necessary to employ another rowboat as a towboat to counteract these conditions.

Channel ranges, such as served in the ledge removal, are also used for sweeping. These lines are spaced 25 feet apart. The sweep-boat is allowed to drift broadside, or at an angle of 90 degrees to the range, and the stern is held right on the range by the boatmen pulling or backing with the oars, whichever is necessary.

The sweep is set agreeably to the depth of the channel plus the height of the tide, which is relayed by the tide observer who is stationed at a convenient tide gage. When shoals are encountered, the sweep is utilized to take soundings. For this purpose, it is hauled up to clear the shoal and then lowered once more—the sounding being made at about the same time by both tenders who call off the reading. This work is repeated until the required depth of water is again reached.

Angles are read by the sextant observer from his place in the stern of the boat, which is held on the range line as just described. The angle taken lies between this range line and a predetermined point on shore. These angles locate the position of the sweep-boat along the line being swept. Angles are taken at the start and at the finish of each line to indicate the area covered, as well as at the beginning and the end of each shoal encountered to indicate the shoal area. Soundings, tide readings, and angles are noted by the recorder; and, when plotted, furnish essential data concerning the condition of the channel.

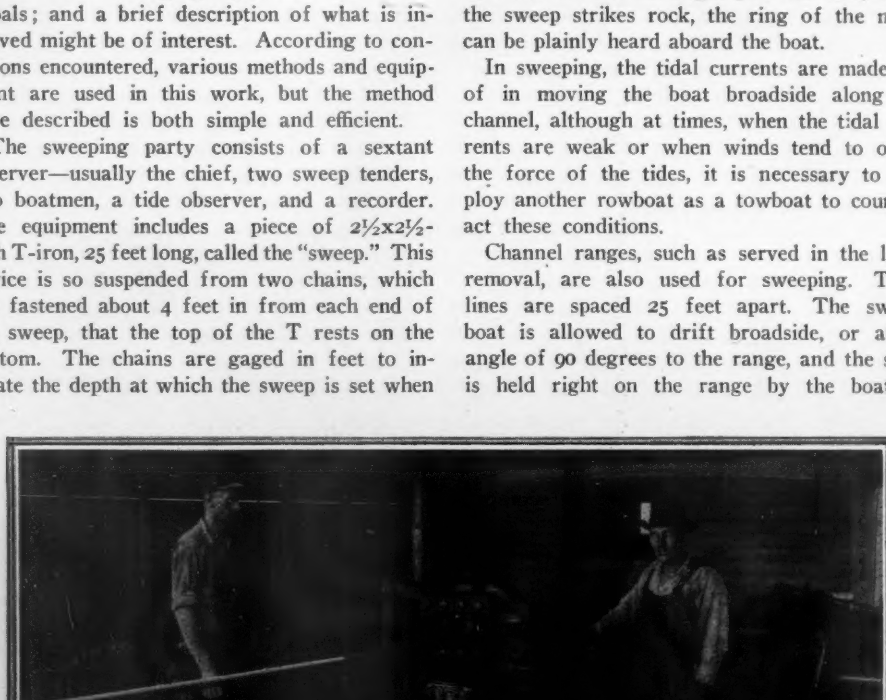
Sweeping of this sort is very important in connection with the supervision of dredging operations. When an area has been swept and found clear, it is certain that no obstructions exist there, whereas with a sounding lead, no matter how closely an area may be covered, it is always possible to miss sharp pinnacles. When shoals are discovered during sweeping, their sizes and positions can be so accurately determined that no trouble is encountered subsequently in spotting either the dredge or the drill boat over such projections.

The harbor improvement work at Beverly is under the supervision of Major F. K. Newcomber, Division Engineer of the Corps of Engineers of the United States Army, and is to be completed during the spring of 1927. The prosecution of the rock removal is under the immediate direction of Mr. Frank J. Murphy, President of the Bridgeport Dredge & Dock Company.

GREAT POWER PROJECT IN CANADA

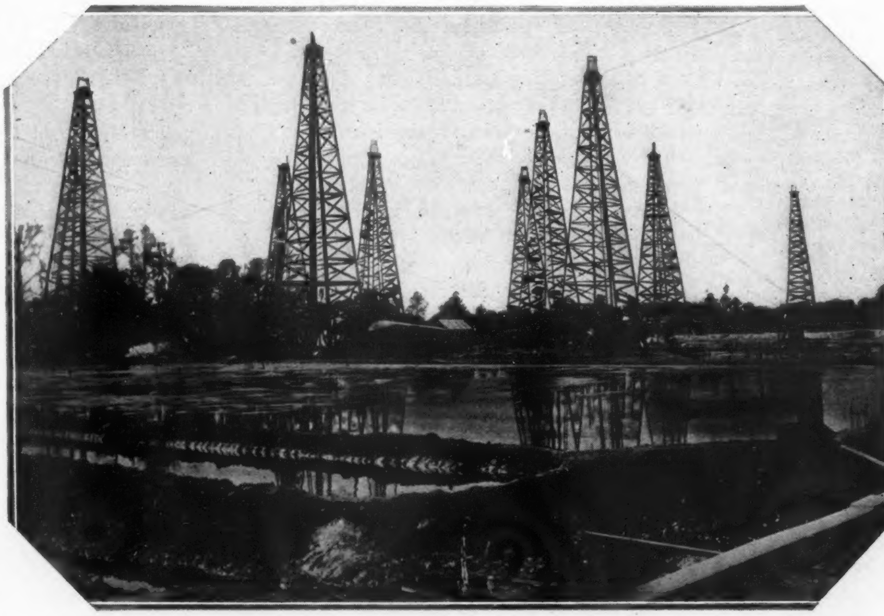
A blast of dynamite, recently fired, marked the beginning of a great hydro-electric project in Canada that will involve the expenditure of from $25,000,000 to $40,000,000. This is only another of the large enterprises promoted by the International Paper Company.

A dam is to be built across the St. John River, at Grand Falls, N. B., at a point where it makes a spectacular drop of 74 feet. From the basin so formed, a tunnel—to underrun the town, will convey the water to a station below the falls where 60,000 H.P. will be developed. By providing adequate storage facilities for the waters tributary to the St. John, it is said that three times the initial power can be obtained. While some of the current will be distributed throughout the province for industrial purposes, most of the electric energy will be used for the production of pulpwood for newsprint and other paper.



The floating blacksmith shop is equipped with a No. 50 "Leyner" sharpener.

Bringing a "Junked" Well in By Air



In the Humble oil fields. The well at the extreme left is the one that was made productive by recourse to compressed air when the situation looked most unpromising.

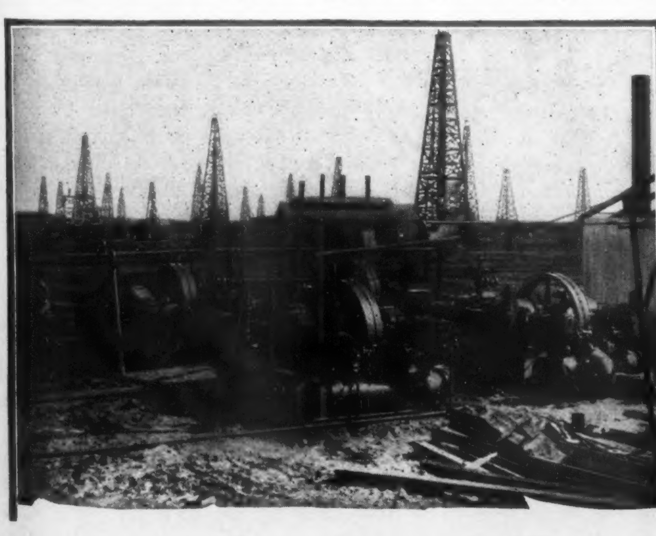
IN the language of the oil fields, a "junked" well is a well that has been abandoned for one reason or another and, therefore, no longer considered a likely source of petroleum. One such well on the property of the Humble Oil & Refining Company, at Pierce Junction, Tex., is of more than passing interest because that well was made to yield oil in profitable quantities through the skillful use of compressed air when the situation appeared to most observers to be extremely unpromising.

We are indebted to Mr. J. A. Tennant, of Tennant-Lovegrove Company, Houston, Tex., for the accompanying data about how the well in question was made to "come back." According to Mr. Tennant: "This well had been drilled by the usual rotary method, and about 2,500 feet of 8-inch casing had been set. Below this 8-inch casing had been set approximately 800 feet of 6-inch casing, with the usual packer between the 6-inch and the 8-inch sections. This packer gave trouble from the very first; and the men drilling the well were never quite certain about what had happened to the packer.

"At the bottom of the 6-inch pipe, the well drillers started a string of 4½-inch pipe, with a strainer attached. The upper end of this 4½-inch pipe was fitted with a swedge nipple, to which was connected a 3-inch drill stem. Below the 4½-inch pipe was something like 300 feet of 2-inch wash pipe. When the well drillers tried to pull this 4½-inch pipe out, the swedge nipple caught in the well where the packer was set at the junction of the 6- and 8-inch sections, and broke loose. This allowed the 4½-inch pipe and the 2-inch wash pipe to fall to the bottom of the well. It was then found impossible to get a 4½-inch line into the top of the 6-inch pipe. There was every indication that the 6-inch pipe had pulled out on account of the faulty packer.

"When oil was discovered in the hole, it was decided that the only thing to do was to run a drill stem down through the casing as far as would be permitted by the string of loose pipe already in the well. This was done and a connection successfully made with the swedge nipple on top of the string of 4-inch pipe resting in the bottom of the well. With this accomplished, compressed air was then turned on. It required close to 800 pounds to blow off the head, and 520 pounds as a continuous operating pressure. The well yielded approximately 800 barrels of oil a day to start with, and the production steadily dwindled down to about one-tenth of this amount at the end of 60 days. This meant an average production of 440 barrels per day for 60 days, or 26,400 barrels for the whole period—having a market value at the time of $1.25 a barrel."

On the occasion of the annual automobile endurance race at Le Mans, France, when numerous cars pounded a long circuit at high speed for 24 hours, a severe test was given to three types of road surface. It is declared that the different surfaces—tarred macadam, macadam "vialite," and "calcaire silicate" or crushed limestone treated with a solution of silica—withstood the test satisfactorily. As a result, they are to be used in about equal proportions on roadwork in the Sarthe.



When the "junked" well had been "brought in" by compressed air, it was made to continue to flow by air furnished by an X-2 type compressor, such as these pictures show.

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EDITORIALS

HOLLAND TUNNEL NEARING COMPLETION

THE twin tubes of this vehicular tunnel beneath the Hudson River are finished; the governors of the two states immediately concerned have journeyed to and fro beneath the water to mark the climax of this notable engineering undertaking; and all that now remains necessary to make these traffic arteries available to the public is the installing of the ventilating apparatus and the completing of the land approaches. If all goes well, and the outlook is promising, motoring thousands may use the tubes early in 1927.

Looking back to 1919-20-21, it will be recalled that a number of outstanding technical questions were then the subjects of earnest debate even though the vehicular tunnel in principle was agreed upon. The ultimate choice of the present type of structure was determined upon only after CLIFFORD M. HOLLAND, then chief engineer of the project, had demonstrated conclusively that any other form of construction would involve uncertainties that might prove ruinous. He believed that it was better to build upon the sure foundation of experience than to embark upon experimentation which might involve the wasting of many millions of the public's funds. It was therefore fitting that the work to which MR. HOLLAND gave his best—in fact, gave his life—should bear his name.

Actual construction of the tunnel began in 1922; and since then everyone concerned has done his utmost to push the project forward to completion. From portal to portal, each twin tube is 9,425 feet long and has a diameter of 29 feet. The fact that the tubes will form subaqueous highways for automotive vehicles has necessitated prolonged and painstaking research in determining the means by which the tubes could be surely and effectually ventilated so as to prevent a dangerous accumulation of deadly carbon monoxide—the noxious gas exhausted by internal-combustion engines. The work done in connection with this problem will probably remain a classic in this field of investigation for years to come. In the same thorough fashion, other problems were analyzed and successfully solved; and each and all of these will be of service in promoting the building of those other vehicular tunnels already demanded by the swelling numbers of automobiles and motor trucks.

The readers of this Magazine do not have to be reminded of the various ways in which compressed air has been utilized in carrying forward the driving and the completing of this difficult undertaking.

FINE PROGRESS BEING MADE ON WELLAND CANAL

COMPARATIVELY few of us are aware of the splendid and costly work which Canada is doing in remodeling the Welland Canal. This project, when finished, will represent an expenditure of quite $115,000,000, and will be an important part of the waterway system which ultimately will link the Great Lakes with the Atlantic Ocean by channels that will be deep enough to accommodate seagoing shipping.

The original Welland Canal was made ready for service in 1833; and years back the old locks ceased to be adequate for the tide of traffic that set that way. Therefore, the Dominion Government decided upon remodeling the canal upon generous lines; but this momentous work, started thirteen years ago, was hampered by the World War. When that period of strife was over, however, the Canadians set about making up for lost time; and, if all goes well, the canal will be completed in 1930.

Some idea of the magnitude of this modernized waterway can be grasped when it is recalled that one of the locks has a length of 829 feet, and a depth of 25 feet will be available at the start—that is to say, the depth will be increased in the future should the growth of shipping demand it. The old Welland Canal, through which 1,000 vessels passed last year, has a depth of only 14 feet and, accordingly, greatly restricts the size of craft that can traverse it. The increased depth which will be available in the new canal will open the route to much larger and longer ships. The bigger and better Welland Canal will have only 8 locks, whereas shipping using the old canal must pass through 26 locks, which helps to explain why it has been practicable to put but 48 boats through the canal in the course of 24 hours when handling the autumn rush of grain-carrying vessels.

Many of the engineering features of the new Welland Canal are of monumental magnitude; and, in its importance as a shipping artery, the new canal will rank next to the Panama and Suez canals. In the digging of this up-to-date inland water route, a great deal of rock has been drilled and blasted to effect its removal; and in this essential work the air compressor and the pneumatic rock drill have played prime and indispensable parts.

SCIENTISTS ARE TO HUNT FORMIDABLE DRAGONS

RECURRENT tales of sea serpents no longer disturb the calm of the scientific mind even though the general public may be lured into credulity. However, something in the way of equally mysterious forms of animal life have been discovered, so it is said, on Komodo Island off the coast of Australia.

ALAN COBHAM, during his recent long-distance airplane flight from England, alighted upon Komodo Island and there encountered monstrous creatures more or less akin to the dragon which St. George is reputed to have slain. Some of the giant lizards found there are twenty feet long and just as aggressive as they are big. COBHAM is said to have declared that the animals possess huge claws and that, when angered, their steaming breath gives color to the legendary belief that dragons once existed that spat smoke and fire.

The Komodo dragon, scientifically called the monitor lizard, is really a formidable beast, and generally considered by hunters to be much more dangerous than the crocodile. In all likelihood, these isolated and disappearing forms of animal life are survivors of prehistoric creatures, and because of this and their scarcity they are of especial interest to the scientist. This explains why an expedition is going from the United States to Komodo Island for the purpose of capturing some of these lizards for preservation.

SUPER HIGHWAYS NEEDED

WIDER roads, super highways, and double-decked streets as means of relieving congestion are recommended in a report recently made by a committee of the National Conference on Street and Highway Service.

The very speed at which motor-driven vehicles can travel tends, strange as it may seem, to promote congestion and the costly slowing down of the flow of traffic. Just what this represents in the way of monetary loss has been carefully ascertained in a number of instances. According to the report in question: "Commercial losses from traffic congestion are becoming serious in the large cities. Records kept by a Philadelphia taxicab company show that its cabs lose on an average of $2.50 per day each because of traffic congestion. The loss in one year represented 9.5 per cent. of the working time for a fleet of 836 cabs. Applying half the loss shown by the Philadelphia cabs to the 900,000 automobiles registered in New York City, the committee arrived at an estimate of more than $1,000,000 a day lost in New York alone.

"For the entire United States, it was conservatively estimated that the loss runs up to an average of $10,000,000 a day. The fuel loss and the wear and tear on cars and trucks, due to stopping and starting at street intersections, are comparable to the loss in time."

On the face of it, the situation is one that calls for prompt action; and it is self-evident that large sums of money can be spent to advantage in providing thoroughfares and roads capable of accommodating the ever-growing stream of automotive traffic so as to reduce the monetary losses now resulting from congestion.

OUR EXPANDING TRADE IN MANUFACTURED GOODS

SUCH, in substance, is the topic covered by JULIUS KLEIN in a recent issue of *Commerce Reports*. This recognized authority adds cumulative weight to the widespread opinion that America's industrial life is generally in a very favorable position—a position which it is likely to hold in the future unless the unforeseen happen.

According to this expert, the fiscal year just closed brought once more into striking relief the rapid growth in American exports of manufactured goods and the immense importance of foreign sales of this class as a stabilizer in our total foreign trade, as well as in our domestic industry.

As he tells us: "Exports of finished manufactures increased as compared with the preceding fiscal year by no less than 16 per cent. They were 60 per cent. greater than in 1921-22 —only four years back. They were nearly three times as great in value as in the 5-year period before the war. Even after allowing for higher prices, they were more than double the pre-war average.

"This tremendous growth reflects the ever-rising efficiency of American industry and the energy and intelligence of American salesmanship in foreign markets. The American manufacturer has evidently disposed of sundry tattered scarecrows which used to startle his timid predecessors as they ventured along the strange paths of export. He no longer turns back at vague warnings regarding 'slipshod American packing,' 'inadequate credits,' inexperienced export technique,' or 'inferior foreign-trade financing.'

"These threadbare bugaboos have been most effectively dispelled by the uninterrupted growth of the oversea markets for our manufactures. Regardless of depreciated European currencies and low wages—in fact, partly because of the low standards of living and of efficiency which they imply—the intelligence and resourceful adaptability of the American manufacturer, backed by a firm policy as to quality in goods and service as against cut prices, have made a place oversea for American fabricated wares which bids fair to continue its steady expansion."

The Fifth National Exposition of Power and Mechanical Engineering, to be held in New York City, is scheduled to take place from December 6 to 11 in the Grand Central Palace. Present indications are that the event will far surpass last year's exposition.

Colombia has the distinction of being the only country in South America having ports both on the Atlantic and the Pacific Ocean.

SHIP MODEL MAKING, by Capt. E. Armitage McCann, Marine Consultant. A copiously illustrated work of 129 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $2.50.

THE purpose of the book is to enable anyone handy with a carpenter's tools to make worth-while models of decorative ships —models for which there is a market and models that, in the making, give the fabricator a wealth of pleasure.

We are informed by the author that the purpose of his book is to strike a happy medium between the purely decorative ship and the exact-scale model; and to aid the worker there have been provided two large plans. The two ships so presented are scale replicas of real ships to this extent: that, in their main dimensions and such details as are presented, they have been designed, after exhaustive research, to be as near the ships of their period and country as can be achieved with the adopted method of simplified building.

Because of their picturesqueness and because of the parts they once played in maritime history, Captain McCann has confined his plans and his building directions to the felucca of the Barbary pirate and the galleon of ancient Spain. A lad with a mechanical bent or a person of maturer years intent upon developing a creative hobby should find the book well worth having.

BUSINESS ETHICS, by James Melvin Lee, Litt. D. This is a work of 312 pages, published by The Ronald Press Company, New York City. Price, $3.25.

DOCTOR LEE points out that "As business has grown bigger the necessity has grown keener for manuals that will consider trade morals in a broad way. Most errors in moral conduct result from a failure to list all the factors before a conclusion is reached. Consequently, this fact has been stressed over and over again throughout the present volume. The point of view in the text is for the most part one that looks outward. The numerous codes given in the appendix, on the other hand, have the point of view that looks inward. Both points of view are necessary if conclusions about business relations are to be fair and just. In some respects it would have been better if the order of presentation could have been reversed: the beam that is within one's own eye is the first that should be removed. Therefore, the various codes, trade practices, trade customs, trade principles, etc., that are printed in the appendix deserve a most careful reading. They deal with specific matters, and the error that points the way to right conduct is easily seen."

Finally, the author says: "To show that the problems of business ethics are not so simple as they seem has been one of the main purposes in the preparation of the text. Seldom, if ever, will a conclusion be reached that can be justified in every detail. Business life for the most part is made up of compromises. To err in ethics, as elsewhere, is human. Consequently, what may be called rough justice is about all that one may hope to give and, incidentally, it is about all that one may expect to receive from his associates."

The man of business, the industrial executive, will find this book a valuable and a suggestive compendium and a helpful guide in solving those ethical problems that arise from time to time in the broad field of trade.

ENGLISH APPLIED IN TECHNICAL WRITING, by Clyde W. Park, Professor of English, College of Engineering and Commerce, University of Cincinnati. A book of 313 pages, published by F. S. Crofts & Company, New York City. Price, $2.25.

MANY subjects of a technical character—treated in articles, papers, and books by recognized authorities, fail in their appeal largely by reason of the involved manner in which they are written and because their authors use what might properly be termed "occupational lingoes." These writers on technical topics are carried away by the importance of their message and give indifferent heed to the fact that they are supposed to be employing a familiar language that can be abused only so much without inviting confusion and misunderstanding. Furthermore, these gentry fail to grasp the fundamental essentials of developing their subject in an orderly manner and of grouping their statements in a logical fashion.

Professor Park has endeavored to make it plain that there is properly no such thing as "engineering English"; but, on the other hand, that English should be considered as English regardless of the subject matter with which it happens to deal. This means, of course, that the would-be writer should give much time to the study of composition; and, along with the fundamental virtues of clearness and a correct use of words, the student should develop resourcefulness and critical taste.

We strongly commend Professor Park's book to anyone desirous of writing upon technical subjects for the double purpose of being informative and interesting. The mind in search of facts has a keener zest when stimulated by a pleasing presentation of those facts. Conversely, the reader can be dismayed and discouraged at the outset by an awkward or an involved way of treating the subject matter.

RAILWAY TRACK AND MAINTENANCE, by E. E. Russell Tratman, Associate Editor, Engineering News Record. An illustrated book of 490 pages, published by McGraw-Hill Book Company, Inc., New York City. Price, $5.00.

THIS work first appeared in the autumn of 1897, and the present volume, the fourth edition, is a thoroughly rewritten and enlarged presentation of the theory and the practice of railway tracks and their maintenance.

As the author explains: "Railway engineering was considered for many years as being limited mainly to location and construction, while the maintenance and repair to keep the lines in condition were considered as matters for foremen and laborers. It came to be recognized, however, that both the track construction and the state in which it is maintained have an important bearing upon the efficient and economic handling of traffic, and as a result there has been a marked development in the position and work of the engineer in relation to maintenance of way."

The volume is a valuable and a comprehensive treatment of a very important subject. The author has presented his material in a logical and a clear way so that either the student or the practical man can readily obtain the instruction or the information desired. A very interesting part of the work is the revelation of how mechanical aids—power-driven tools, etc.,—have reduced the cost of track maintenance and incidentally insured better and more lasting results.

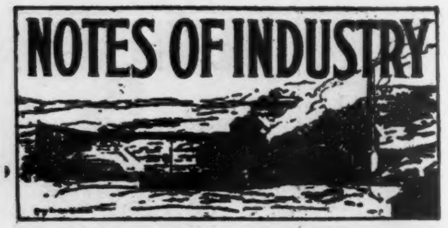
IRON MINING IN LAPLAND

LAPLAND, of which most of us know little more than that it is the land of the Lapps and lies in the Arctic region, has one claim, at least, to distinction. We learn from *The Explosives Engineer,* that in Lapland, at Kiruna, are the world's largest deposits of almost pure magnetite and that these are being worked on an enormous scale and by the most approved methods. The main ore body is about 2.2 miles long; the vein has an average thickness of about 315 feet; and the ore, carrying a small percentage of phosphorus, analyzes 60 to 70 per cent. iron.

With a crew of 1,500 men, working in two 8-hour shifts, there was produced in 1925 a total of 4,300,000 tons of ore, or about 15,000 tons a day. And in this connection it is interesting to note that despite the rigors of the winter season the work goes right on, and the men rarely lay off because of the cold. Just what this means can be appreciated when it is understood that the operations are at present confined to open-cut methods.

The ore is removed by bench blasting. The hanging wall is first stripped, and then holes are drilled vertically downward from the top of the bench and horizontally in from the foot of the bench to a depth of from 20 to 22 feet. Numerous air-operated drills are used for this purpose. All deep holes are sprung to provide pockets for the main charges of dynamite. Electrically driven shovels handle the ore, which is subsequently crushed and sent through chutes to a loading tunnel where 20-car trains, with a capacity of 700 tons, are loaded in from 15 to 20 minutes.

Not long ago, a serious conflagration in a large warehouse in Batley, Yorkshire, proved that concrete floors possess great fire-resisting properties. The outbreak occurred on the ground floor. Though that section of the building was practically burned out, the concrete floor overhead prevented the flames from spreading to the upper stories of the structure.



Statistics, recently compiled, reveal that there are under construction throughout the world 355 marine-engine sets, aggregating 1,552,550 H.P. Of these, 43, or 370,594 H.P., are reciprocating steam engines; 39, or 399,740 H.P., are steam turbines; and 273, or 782,216 H.P., are oil engines. In other words, the oil engine is in the lead—representing 77 per cent. of the total.

There has just been completed on the Island of Oahu, a 100,000,000-gallon water tunnel. This tunnel is designed not only to supply more water to the lands already under irrigation but to make a larger acreage productive. Additional irrigation facilities, including a 3,000-kilowatt steam-turbine generator and high-lift pumps, are also being provided on the Island of Maui. The activity in this direction by Hawaiian sugar planters is said to be due to the introduction of a new kind of cane that requires twice as much water but yields double the amount of sugar obtained from the older variety.

Milk consumption in the United States is on the increase—116,505,395,000 pounds having been used last year, or 2,000,000,000 pounds more than in 1924. As most of it was used as a beverage, according to the Department of Agriculture, this means that every person in the country drank substantially 100 pounds of whole milk in that twelvemonth.

The sulphur mines on the Island of Sicily are to be electrified. The plan is to build a large steam power plant at Catania, and to deliver the current thence by way of 310 miles of transmission line to the principal mining centers.

Preliminary surveys are being made for the construction of a dam, 100 feet high and about half a mile long, across the Santo Domingo Cañon. The water impounded will form a lake approximately 5 miles long and half a mile wide, and will be used to irrigate 25,000 acres on the San Quentin plain in lower California.

A simple and effective lock to prevent the stealing of electric-light bulbs has been put on the market by the Ren Manufacturing Company of Winchester, Mass. The device consists of but two parts, a coiled spring and a grooved ring; and it can be used with standard electric-light bulbs and brass and porcelain sockets. A special punch is used to attach the lock to the socket. When a lamp is thus locked it cannot be removed except by breaking the glass.

A pneumatic-suction grain conveyor, mounted on two standard-gage railway cars, is to be added to the grain-discharging plant at the King George Dock, Hull, England. The apparatus is designed to handle bulk grain arriving in ships that can not conveniently be discharged by the existing bucket elevators. The plant will have a maximum capacity of 60 tons per hour.

The Germans have produced and placed on the domestic market a new motor fuel, called "Motalin." It consists of a gasoline charged with iron carbonyl, and is supposed to act as an "antiknock" for internal-combustion engines.

There has recently been constructed for the Hall Planetary Company a factory that stands unique in that it is made almost entirely of glass—the walls and the roof of the structure being built of actinic corrugated-wire glass. Amber-colored glass is used throughout because it so filters the light rays that only a measure of the heat is transmitted by it to the work rooms. Furthermore, it does not permit the injurious ultra-violet rays to penetrate through to the interior. While the light entering the building is very soft, still it does not prevent the performance of the finest kind of work in any part of the plant. The absence of shadows is a noteworthy feature.

A 4-ton truck that is operated by oil instead of gasoline has lately made its appearance on the streets of New York City. The truck is an importation from Paris, where it was built by the Societé Anonyme des Automobiles et Cycles Peugeot. Automotive engineers and oil-engine experts are said to be impressed with the efficiency of the truck as well as with its low operating cost. It is estimated that the vehicle can run 7.58 miles on a gallon of oil, which costs but five cents.

According to *Rock Products,* a large deposit of pumicite, otherwise known as volcanic ash, has recently been discovered in McPherson County, Kansas. Pumicite is used as an abrasive in soaps and polishes, and latterly has found a field of usefulness in concrete work. The importance of the find can be appreciated when it is learned that, in spite of its increased employment in various domestic industries, there are few large deposits of the substance in the United States.

Something new in the way of a smokeless fuel for heating small factories and homes has been announced by the Rochester Gas & Electric Corporation. This company has been experimenting with liquid tar, a by-product in the manufacture of gas, and claims to have burned this substance successfully in its heating plants last winter. The work has progressed so far that the company is now producing 15,000 gallons fuel tar daily.

Natural gas has been discovered in the vicinity of Johannesburg. The possibility of piping it to surrounding towns for domestic and industrial purposes is under advisement.